Fishery Management Report No. 91-2

Annual Management Report for Sport Fisheries in the Arctic-Yukon-Kuskokwim Region, 1988

by

William D. Arvey
and
James F. Parker

April 1991

Alaska Department of Fish and Game

Division of Sport Fish

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ANNUAL MANAGEMENT REPORT FOR SPORT FISHERIES IN THE ARCTIC-YUKON-KUSKOKWIM REGION, 1988[1]

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[1] Some of the data included in this report were collected under various jobs of project F-10-4 of the Federal Aid in Fish Restoration Act (16 U.S.C. 777-777K).

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ABSTRACT

This report presents a compilation of information on the recreational fisheries of northern, northwestern, western, and interior Alaska, an area referred to as the Arctic-Yukon-Kuskokwim Region. Important species to the sport fisheries in this region are identified, zoogeographic distribution of species is discussed, as is stock status and harvest data during calendar year 1988. Regulatory actions affecting the regional sport fishery in 1988 are described along with other management, research, stocking and enhancement activities. Climatic factors of importance to area fisheries are summarized, and federal land status within the region is described.

KEY WORDS: Arctic, Yukon, Kuskokwim, Tanana River, sport fishery, fishery management, recreation, harvest, effort, abundance, regulations.

PREFACE

This report is the third in a series of annual management reports for Sport Fisheries in the Arctic-Yukon-Kuskokwim Region (AYK Region). The report is designed to document recreational fisheries statistics in the AYK Region, to describe the Department's research and reporting activities, to present pertinent information concerning stock status, to document regulatory changes, and to briefly describe other natural and man-influenced factors that may affect fish survival and production during the reporting period. In addition, long term trends in abundance and/or exploitation are described. Arvey et al. 1990a and Arvey et al. 1990b present similar information for the years 1986 and 1987. The reader is advised to consult other regional reports for specific project information, or, for more abbreviated fisheries summaries, the reader should consult regional reports to the Alaska Board of Fisheries. A brief summary of all reports completed by regional staff during the reporting year with information on how the reader may access them is included later in this report under the section entitled "Synopsis of Published Reports".

INTRODUCTION

The Arctic-Yukon-Kuskokwim Region encompasses the majority of the landmass of the state of Alaska, (Figure 1). Within the region are included some 1,061,000 km^2, the state's largest river systems (Yukon, Kuskokwim, Colville, and Noatak), thousands of lakes, and thousands of miles of coastline and streams. It essentially includes all waters between Cape Newenham in the southwest, (excluding Kuskokwim Bay and the lower Kuskokwim River), the Alaska Range in the south, the Arctic Ocean in the north, and the Canadian border in the east (Figure 1). The region as a whole is very sparsely populated, with the exception of population centers located in the Tanana River valley. Fairbanks (population about 27,000) is the largest of these communities. The Fairbanks North Star Borough Census Area contains about 72,000 people. Other population centers in the region include the Yukon-Koyukuk Census Area with 9,100 people, Nome Census Area with 7,800 people, Southeast Fairbanks Census Area with 6,900 people, Northwest Arctic Borough with 5,800 people, Wade Hampton Census Area with 5,600 people, and the North Slope Borough with 5,500 people (Alaska Department of Labor 1987).

For fishery management, the regional sport fishery program is divided into the Tanana and AYK Areas. The Tanana Area (also called Fairbanks Area) is designated as a separate management area because of the greater impact of its larger human population base upon local fishery resources and the need to conduct more intensive stock specific studies to provide managers with needed biological information.

TANANA AREA DESCRIPTION

The Tanana Area (for harvest reporting purposes in 1988) includes all southern drainages of the Yukon River from its confluence with the Tanana River near Tanana, east to the Canadian border and including the Alaskan portion of the Fortymile and Sixtymile River drainages as well as the entire Tanana River watershed. This area also includes the Alaskan portion of the White River drainage. Although the Tanana Area, for purposes of the statewide harvest report, includes more than just the Tanana River drainage, management responsibilities within the region are limited to the Tanana drainage for the Tanana Area staff.

Geographic and Geologic Setting

The Tanana River basin (Figures 2-6) is an area of approximately 113,900 km^2 (11.4 million ha). The main river is a large glacial stream formed at the confluence of the Chisana and Nebesna rivers near Tok. After flowing downstream in a general northwesterly direction for some 917 km, it meets the Yukon River at Tanana. It is the second largest tributary of the Yukon River; the Porcupine River is slightly larger. The Tanana River receives both the majority of its flow as well as its largest sediment loads from streams draining the glaciers of the Alaska Range and the Wrangell Mountains. All major tributaries flowing into the north side of the Tanana River originate in the Tanana Hills uplands and are clear in both winter and summer. They include the Goodpaster, Salcha, Chena, Chatanika, and Tolovana rivers. Rivers

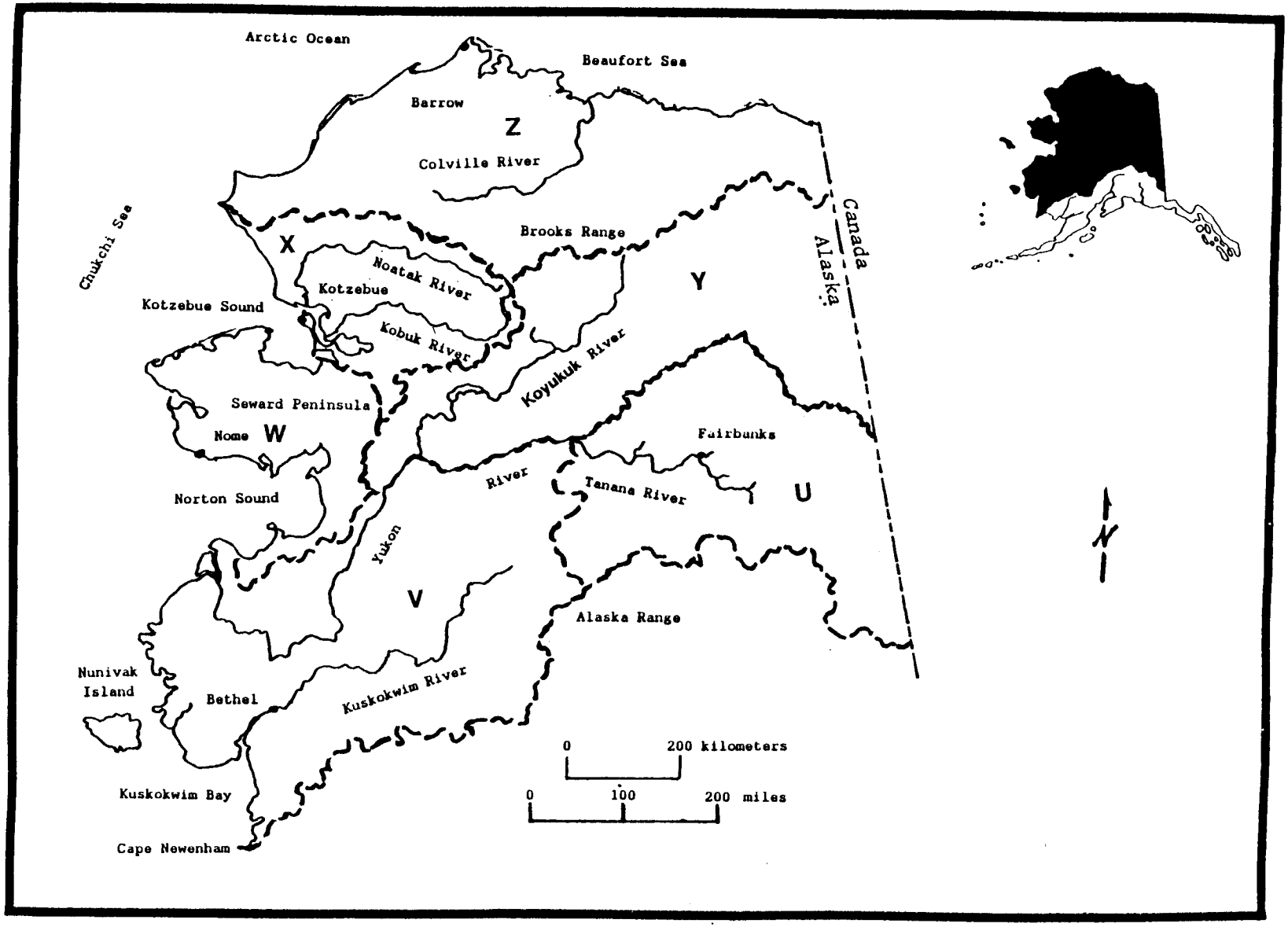

Figure 1. The Arctic Yukon Kuskokwim Region. Dashed lines indicate boundaries between harvest reporting areas U - Z

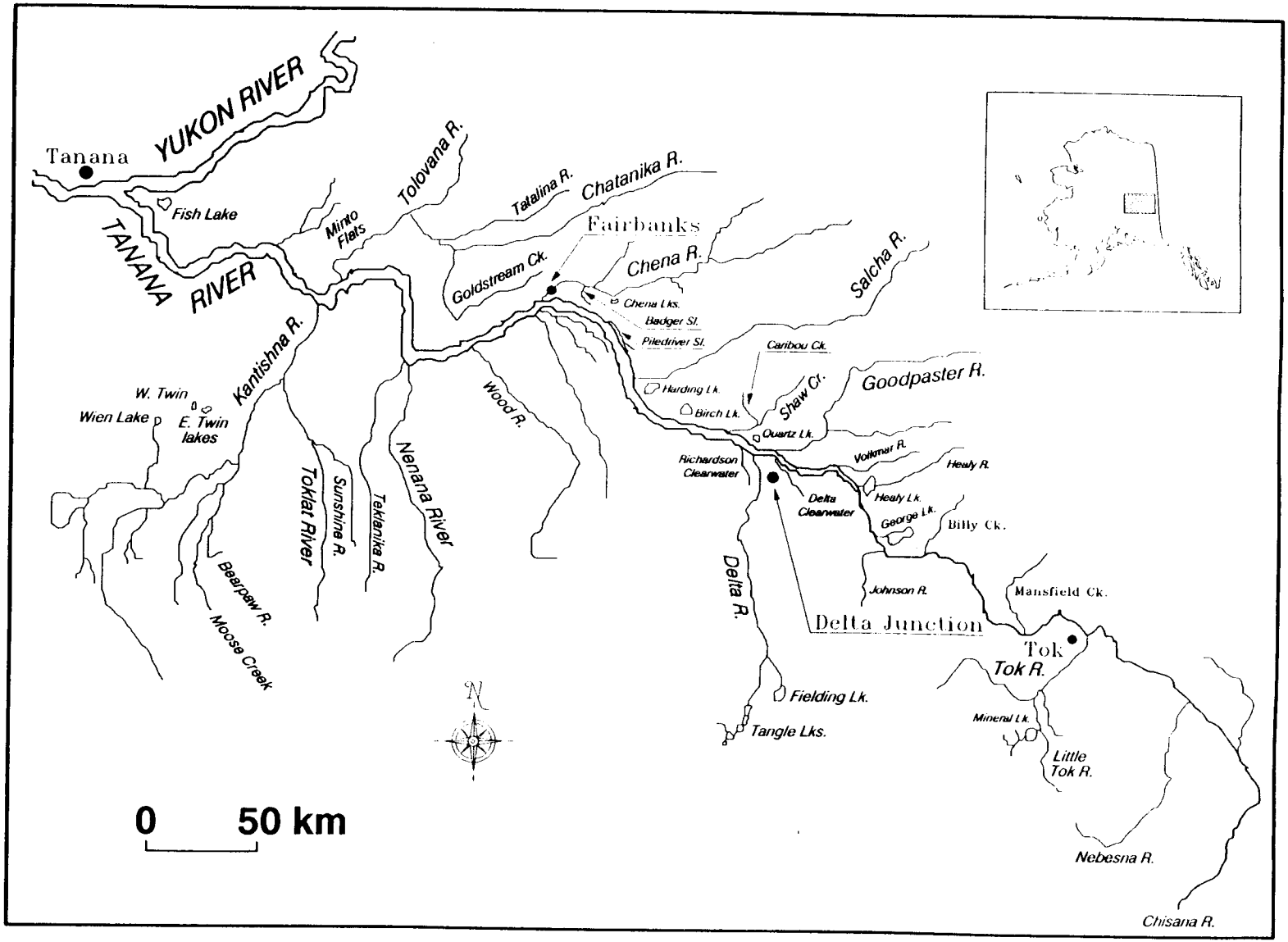

Figure 2. The Tanana River drainage.

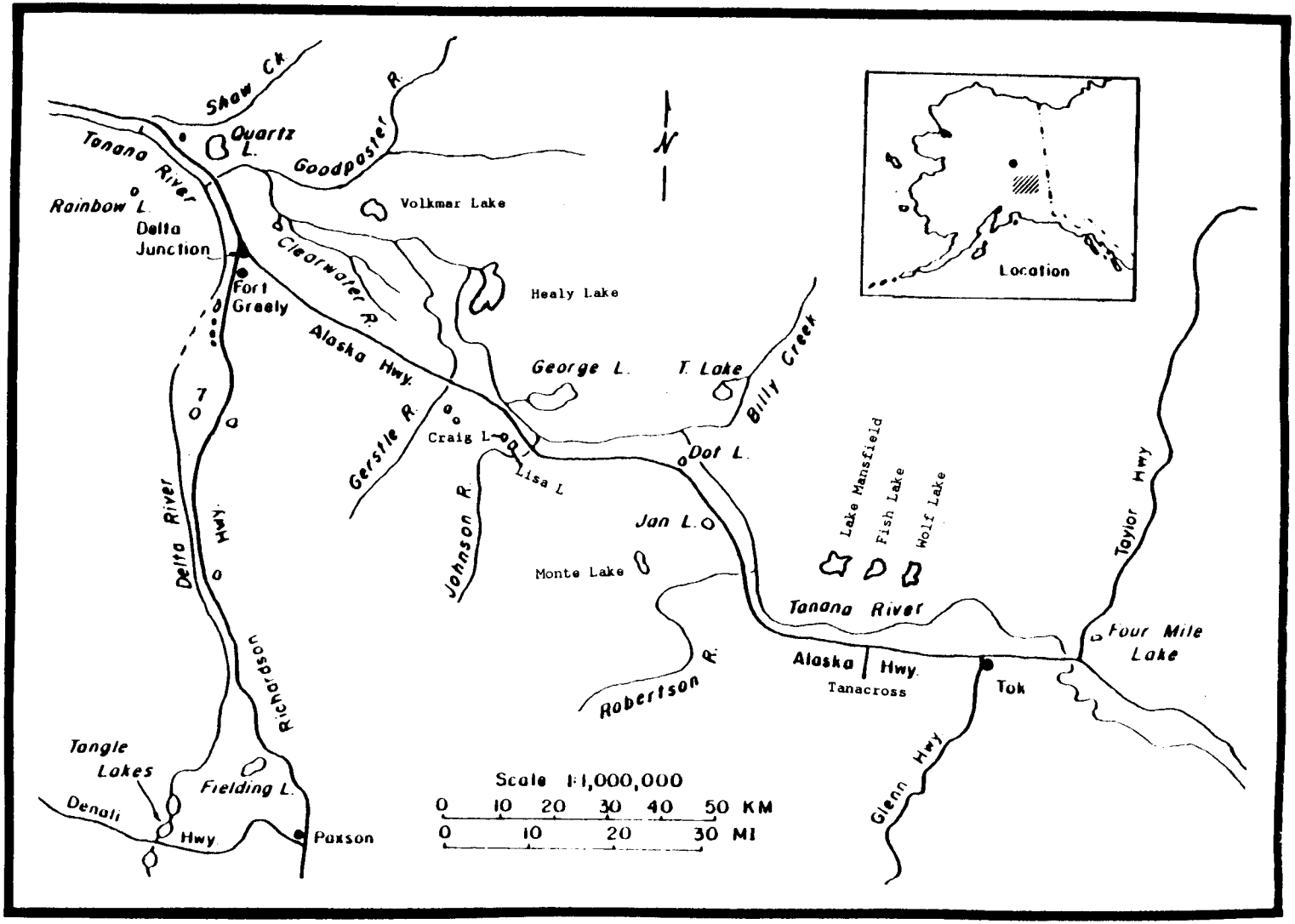

Figure 3. Waters and highways of the middle Tanana River valley.

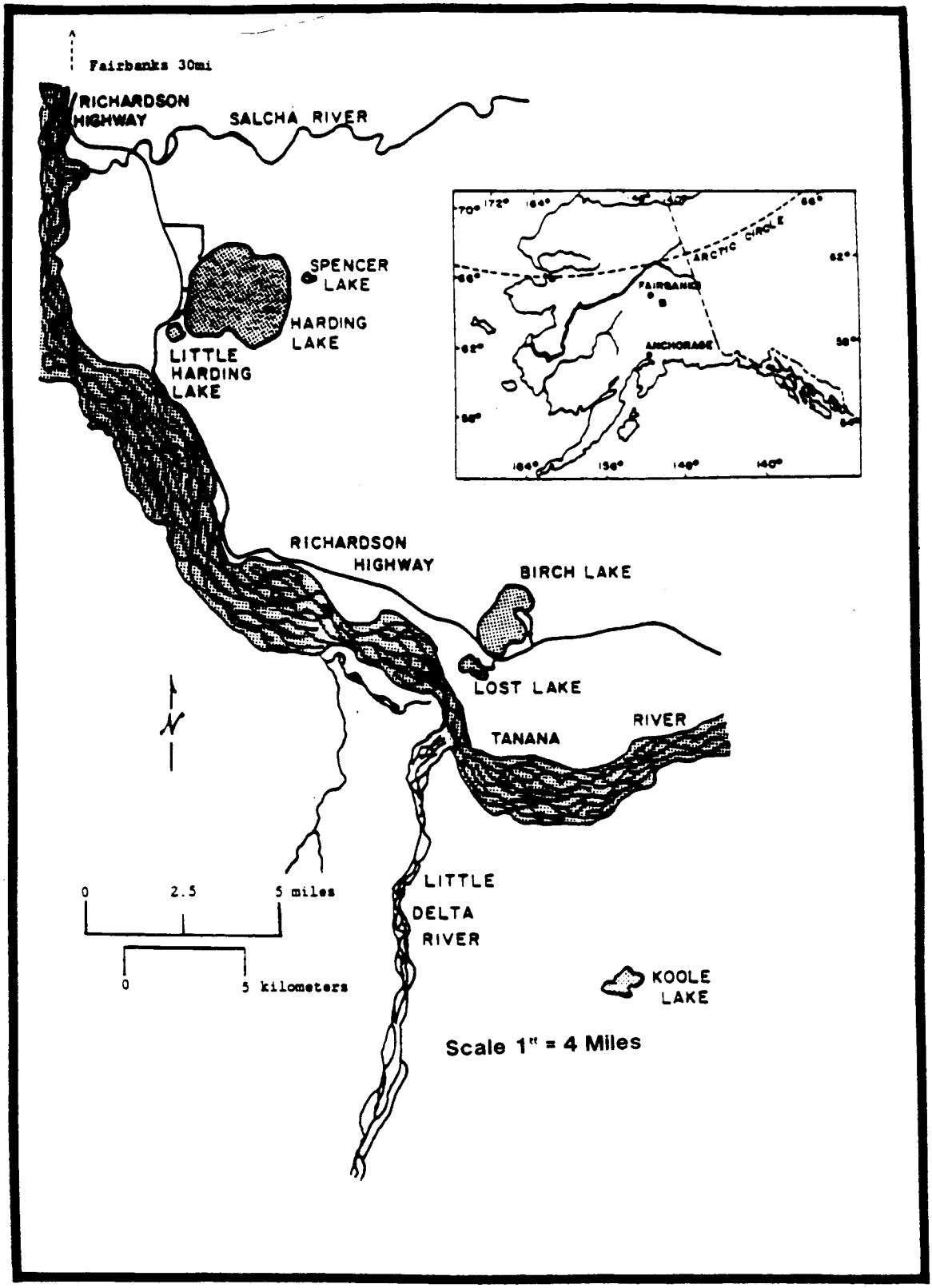

Figure 4. Tanana River waters near Fairbanks.

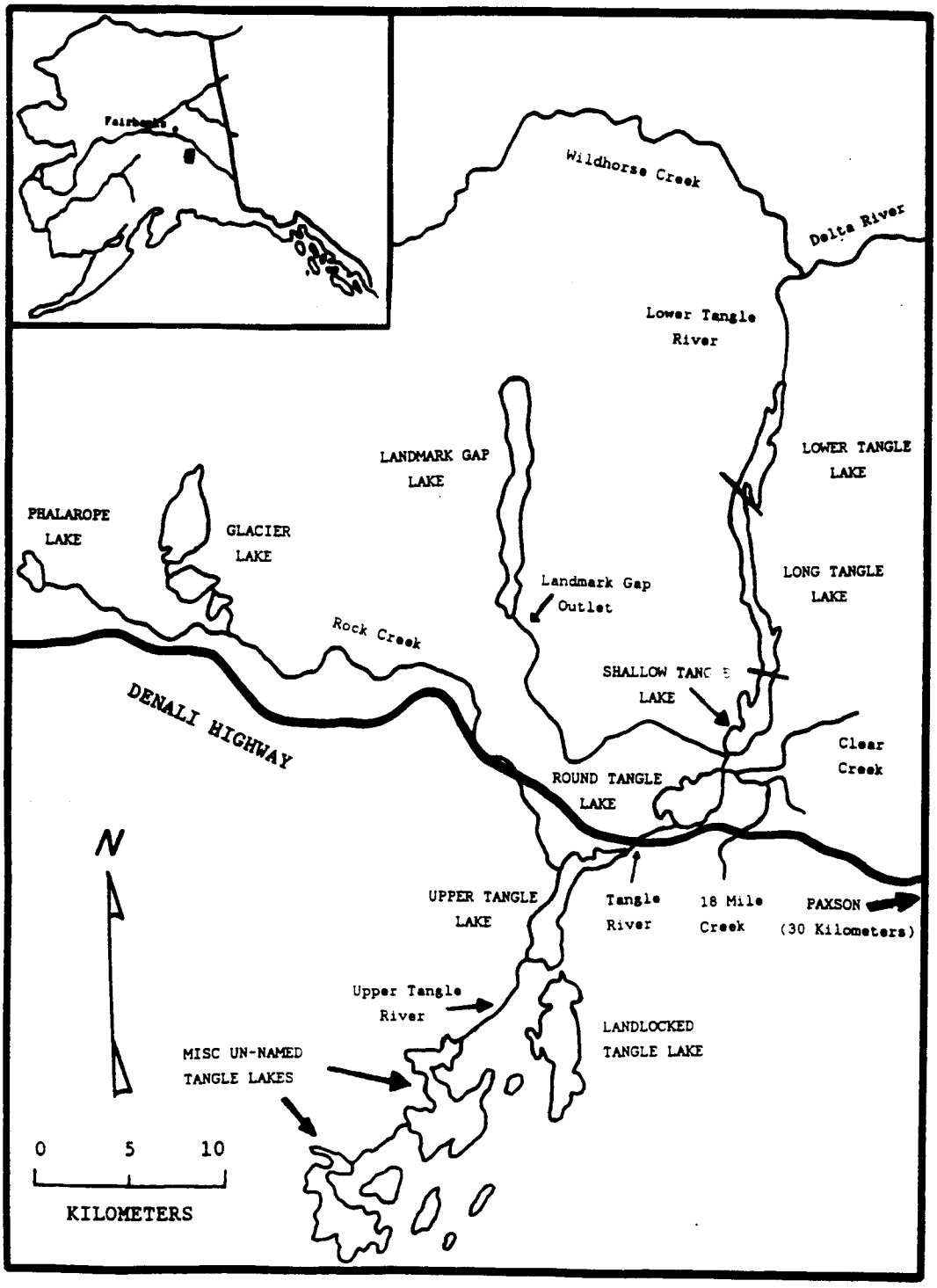

Figure 5. Map of the Tangle Lakes system.

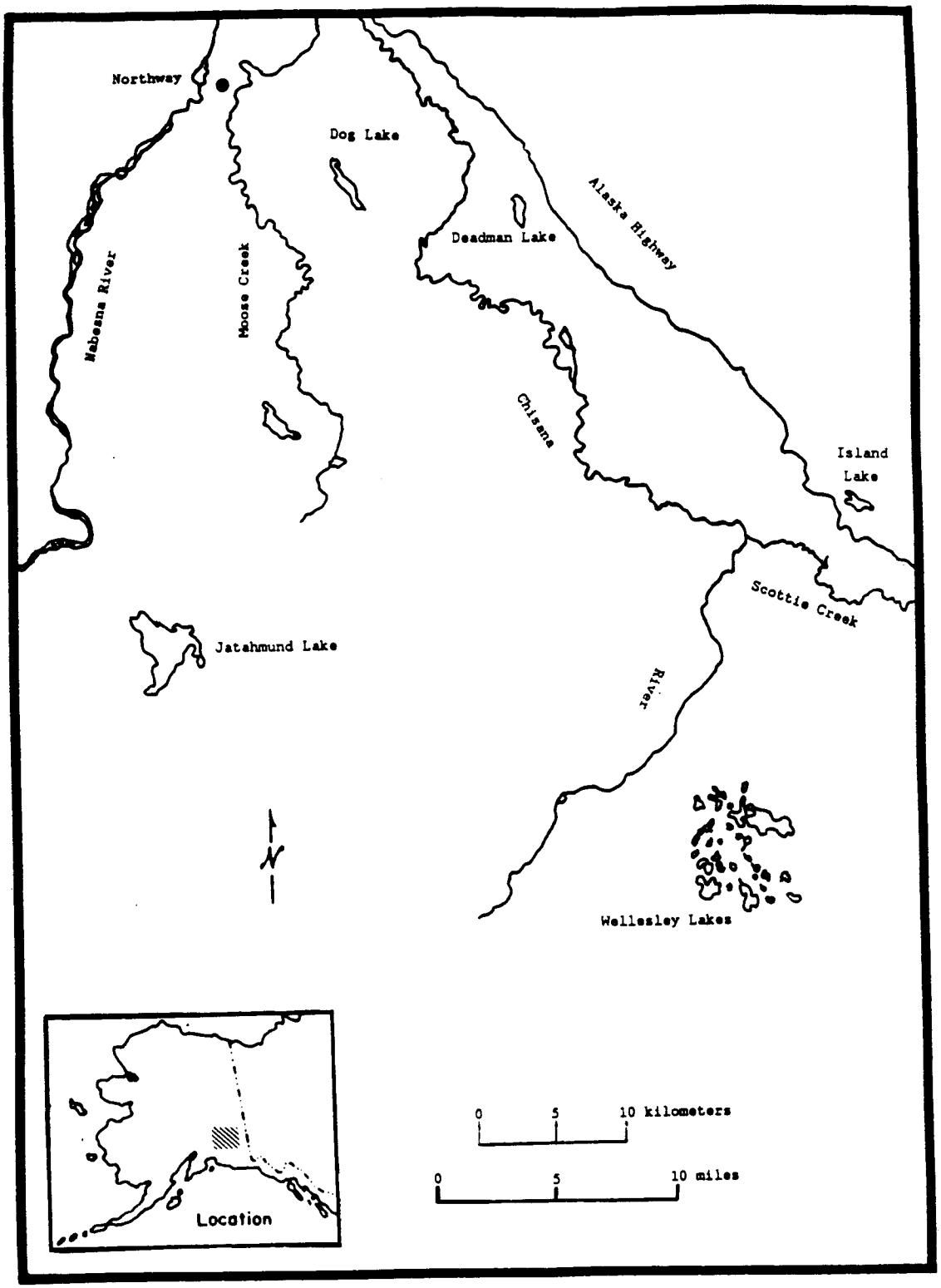

Figure 6. Tributaries of the upper Tanana River.

flowing from the Alaska Range and the Wrangell Mountains and entering the south side of the Tanana River are of glacial origin. They include the Chisana, Nabesna, Tok, Delta, Nenana, and Kantishna rivers (Figure 2).

The Tanana Area (1988 statewide harvest survey definition) also includes the northern drainage of the White Mountains north of Fairbanks. Included are Birch Creek and its tributaries, and Beaver Creek, both of which empty into the Yukon Flats between Circle City and the Dalton Highway crossing of the Yukon River near Stevens Village (Figure 7). This area is contained within the Yukon Flats National Wildlife Refuge. Upstream from Circle City to the Canadian border the Charley, Seventymile, and Alaska portions of the Fortymile rivers are included in the area. The Yukon-Charley National Wildlife Preserve encompasses much of the Yukon drainage upstream of Circle City to the border, including the streams just listed (Figure 8).

Lake and Stream Resources

Large alluvial aquifers associated with porous floodplain gravels influence fish production by storing water and providing more stable winter stream flows in the upper Tanana River and some of its tributaries from Delta Junction upstream and in the Toklat River, tributary to the Kantishna River. All the large aquifers are located on the south side of the Tanana River and are associated with sub-surface water flows from the north slope of the Alaska Range. The Delta Clearwater and Richardson Clearwater rivers (Figure 2) are the most important sport fishing streams that originate from these aquifers. The few on-stream lakes (lakes that are directly on a stream tributary to the Tanana River or on the Tanana River itself) present in the Tanana River system are of insufficient volume to sustain stream flow during winter or through dry summers. Glaciers provide some storage of water that can enhance stream flows in dry summers (Selkregg 1976).

Lake development in the Tanana basin is not as extensive as in many other parts of Alaska. Some 20 lakes within the drainage exceed 26 km^2 in surface area (Selkregg 1976). Most of the water bodies within the system do not contain sufficient volume to influence Tanana River flows, but many are important for sport fishing because of wild or stocked species present in the lakes. Primary lakes for sport fishing within the Tanana River drainage are Harding, Birch, Chena, Quartz, Volkmar, George, Fielding, and Tangle lakes (Figures 3 and 4). Volkmar and George lakes do not have roadside access. Chena Lake (Figure 2) in the lower Chena River basin is man-made, resulting from gravel removal to erect flood control structures during the 1970's. Many of the waters listed are shown in Figures 3 and 4, and the lakes of the upper Delta River are shown in Figure 5.

Lakes are generally ice covered by late October and breakup can occur in late June or early July. Typically, ice thickness ranges from 81 to 102 cm in late winter on interior Alaska lakes.

Lakes were formed in various ways. Some (e.g. Harding, Healy, and George lakes) were created by silt from the Tanana River damming streams draining the surrounding hills. Buried ice masses can melt, resulting in lake formation in the sub-glacial soil. Lakes also form when permafrost melts due to vegetative

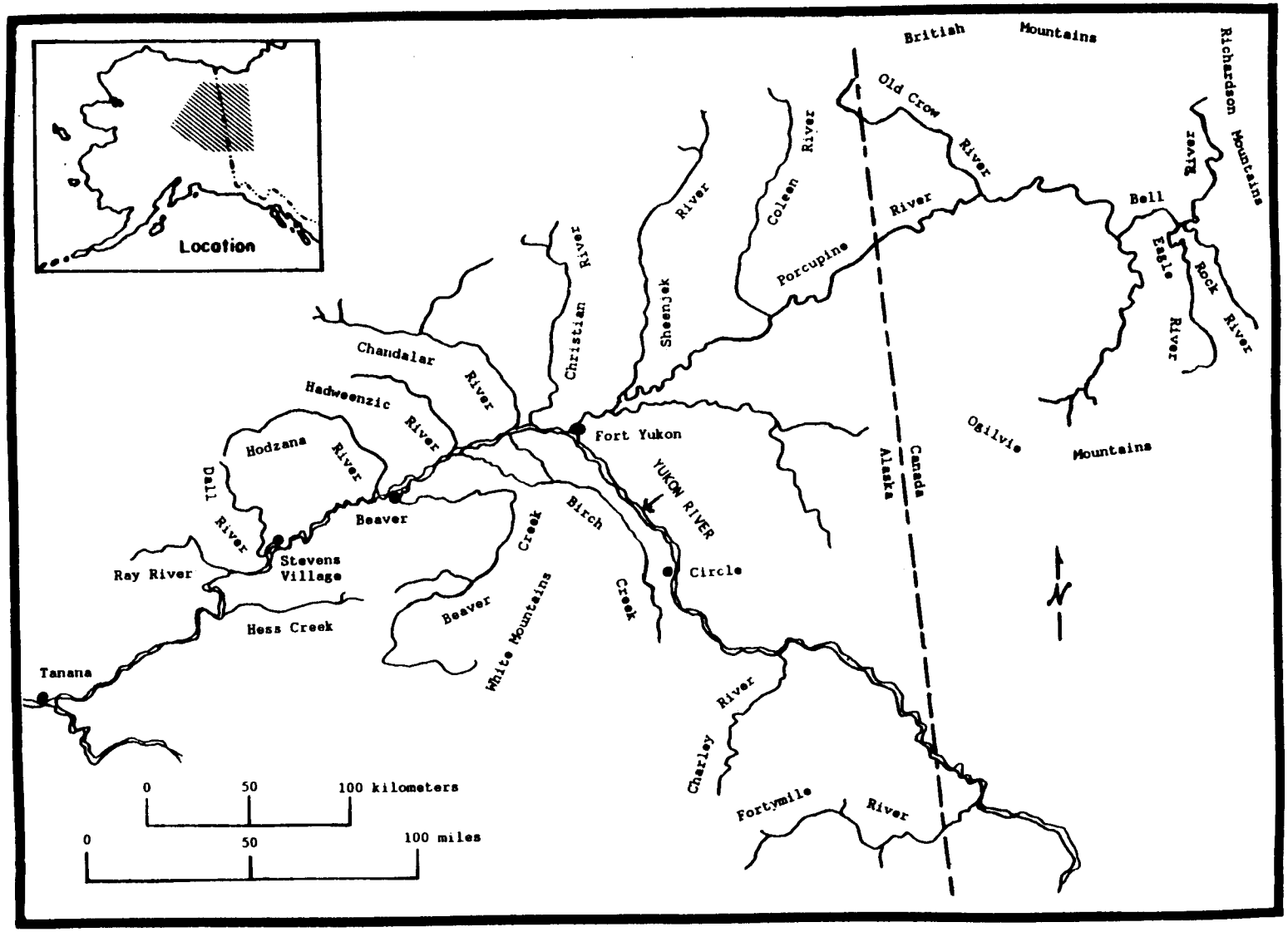

Figure 7. Middle Yukon River and Porcupine River drainages.

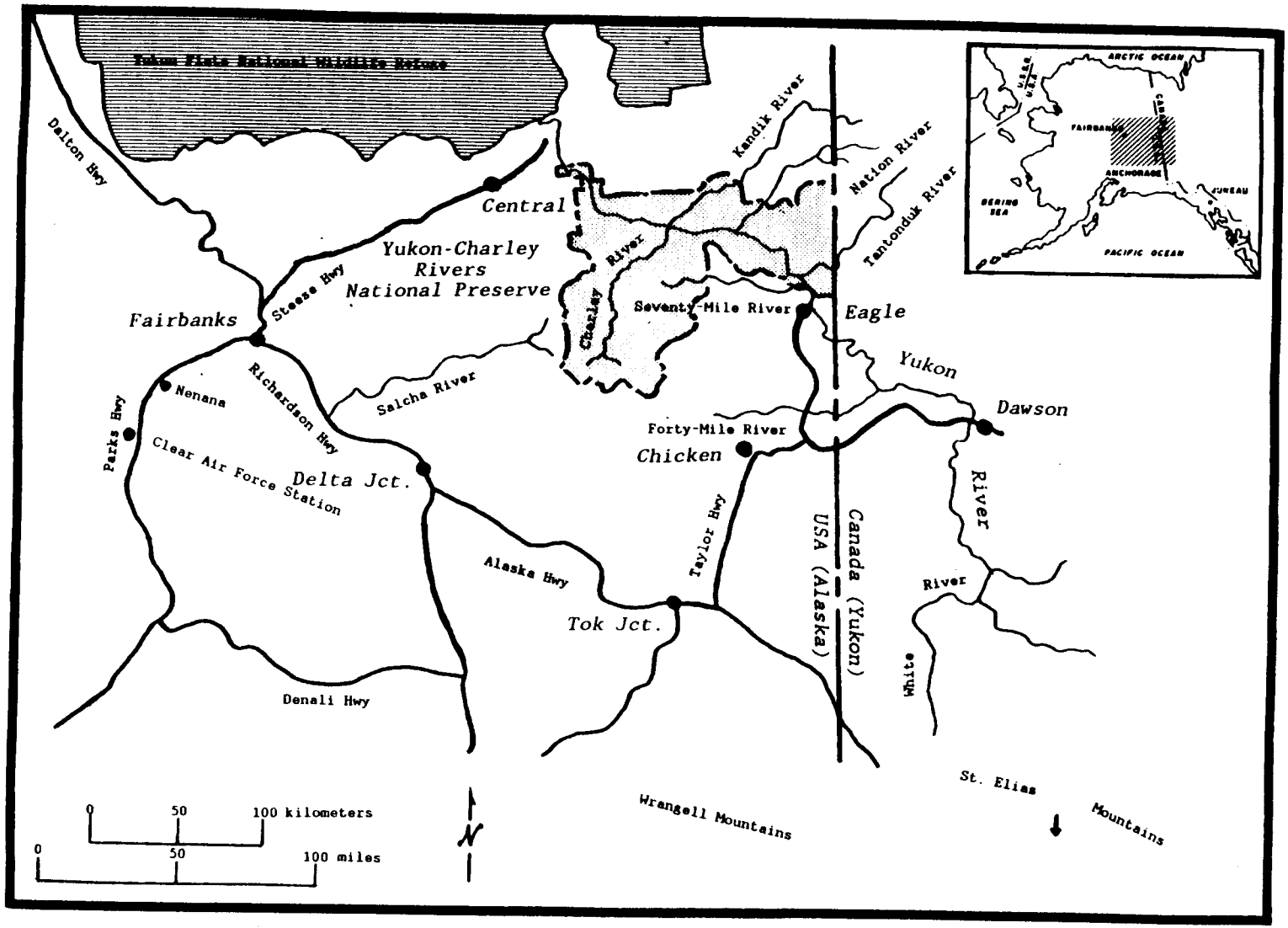

Figure 8. Major highways in interior Alaska.

disturbance. Vegetation insulates permafrost soils, and melting can occur when it is removed (Selkregg 1976).

Climate

Climate in the area is one of harsh contrasts, with spring coming as early as mid-April and snowfall, with sub-freezing temperatures, occurring as late as June. Summers are three months in duration and are characterized by long daylight hours and temperatures occasionally exceeding 32°C. The fall season may extend through early October, with snowfall and decreasing temperatures. Winter lasts from mid-November until mid-March, and during this time temperatures may fall to -57°C. Annual precipitation averages around 28 cm, with most between June and September (USDA 1988).

Species of Importance to the Sport Fishery

There are 17 fish species known in the Tanana area of which 10 are important sport species. They include: chinook salmon *Oncorhynchus tshawytscha*, coho salmon *Oncorhynchus kisutch*, Arctic grayling *Thymallus arcticus*, burbot *Lota lota*, lake trout *Salvelinus namaycush*, inconnu (sheefish) *Stenodus leucichthys*, least cisco *Coregonus sardinella*, humpback whitefish *Coregonus pidscian*, and northern pike *Esox lucius*. Rainbow trout *Oncorhynchus mykiss* are not native to the drainage, but have been stocked in several locations.

Stock Status and Harvest Trends

An average of approximately 72% of the sport fish harvested in the AYK Region is taken from the Tanana Area (Mills 1977-1989). Effort in angler-days in the Tanana Area has increased from 100,000 in 1977 to nearly 175,000 in 1988. In 1988 and for the first time, the harvest of stocked fish was larger than that of wild stocks in the Tanana Area. A brief description of the sport fisheries for the most prominent species in the Tanana River area follows.

Chinook Salmon:

Sport fishing for sea-run chinook salmon in the Tanana River drainage is largely limited to the lower sections of the Salcha and Chena Rivers and to the upper Chatanika River, since these are essentially the only road-accessible tributary stocks available in sufficient abundance to support recreational harvests. Sport harvests in the Salcha River since 1980 have ranged between zero (1988) and 904 (1980) chinook salmon, while harvests from the Chena and Chatanika rivers are small but growing. Harvest estimates for 1988, as documented by the statewide harvest survey, differed substantially from those obtained by the creel survey study. Sport harvest of chinook salmon, estimated by the statewide harvest survey (Mills 1989) in Tanana River drainage streams, apparently decreased in 1988, with the exception of that from the Chatanika River, where 345 fish were taken (Table 1). Harvests estimated by creel survey were larger (567 chinook salmon, Baker 1989) for the Chena River than the harvest estimated in the statewide survey (73 chinook salmon, Mills 1989). The creel survey study estimated a sport harvest of only 19 chinook salmon in the Salcha River in 1988 (Baker 1989), compared to an estimated 236 by the statewide survey estimate (Mills 1989). Sport fishing

Table 1. Tanana Area[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	KI[d]	KS	SS	LL	CS	LT	DV AC	RT	GR	WF	SF	NP	BB
Upper Chena River[e]	5,631	9,684	9,677	18	0	0	0	0	0	0	0	1,896	0	0	43	69
Lower Chena River[f]	6,374	13,490	16,244	55	0	0	0	18	0	0	0	2,686	728	91	137	317
Badger Slough[g]	1,856	4,208	5,930	0	0	0	0	0	0	0	0	746	62	0	273	0
Piledriver Slough	4,981	21,936	24,375	0	0	0	0	0	0	0	12,296	8,095	278	36	182	55
Nenana River Drainage	928	2,135	1,912	0	36	255	0	0	0	291	0	2,620	0	0	36	0
Chatanika River	6,126	11,293	11,642	18	327	0	0	0	0	0	0	8,640	7,983	546	364	55
Salcha River	3,837	6,869	7,494	236	0	0	0	55	0	0	0	2,383	0	0	0	18
Delta Clearwater River	2,413	4,734	5,184	0	0	1,291	0	0	0	0	0	2,910	1,114	0	0	0
Goodpaster River	959	928	1,037	0	0	0	0	0	0	0	0	1,273	0	0	36	109
Delta River (below Tangle Lakes)	526	402	800	0	0	0	0	0	0	182	0	964	0	0	0	0
Brushkana Creek	1,114	835	1,114	0	0	0	0	0	0	73	0	1,164	0	0	0	0
Tanana River	2,258	4,424	4,965	0	0	36	0	345	0	36	0	1,710	1,300	36	1,328	2,419
Other Streams	5,513	9,195	10,578	0	36	236	0	18	91	327	36	7,821	155	54	1,110	364
Birch Lake	9,715	12,190	15,607	0	0	0	5,548	0	0	0	18,390	0	0	0	0	0
Quartz Lake	11,355	16,769	19,391	0	0	0	19,009	0	0	0	25,175	0	0	0	0	0
Fielding Lake	1,114	1,361	1,728	0	0	0	0	0	364	0	0	1,492	93	0	0	36
Minto Flats	1,114	1,454	1,564	18	0	0	0	0	0	0	0	236	31	0	1,128	0
Tangle Lakes	2,413	2,011	2,656	0	0	0	0	0	127	0	0	3,711	0	0	0	0
Chena Lake (Lake only)	3,311	6,931	9,404	0	0	0	2,401	0	0	0	9,877	0	0	0	0	0
Harding Lake	2,599	3,806	3,256	0	0	0	0	0	55	0	73	0	0	73	2,092	73
Other Lakes	9,411	17,268	19,996	109	0	419	5,384	55	1,584	0	12,498	4,312	31	146	5,257	218
TOTAL	36,911[h]	151,923	174,554	454	399	2,237	32,342	491	2,221[i]	909	78,345	52,659	11,775	982	11,986	3,733

[a] Tanana River Drainage (Area U): All southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, to the Canadian border; including the entire Tanana River drainage, and the Alaskan portion of the White River drainage.

[b] KS: chinook salmon; SS: coho salmon; LL: landlocked coho or chinook salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; RT: rainbow trout; GR: Arctic grayling; WF: whitefish of various species; SF: Inconnu (sheefish); NP: northern pike; BB: burbot

[c] From Mills 1989.

[d] Chinook salmon less than 410 mm (16 inches).

[e] The Chena River and tributaries accessed from the Chena Hot Springs Road beyond Milepost 25 on the road.

[f] The Chena River and tributaries from the mouth upstream to Milepost 25 of the Chena Hot Springs Road.

[g] All parts of Badger Slough (sometimes called Chena Slough).

[h] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

[i] Lake trout harvest is estimated at 783. Some angler responses on the statewide survey reported lake trout taken from lakes that do not contain them.

for chinook salmon in the Salcha River was restricted to the lower 8 km of river for the first time in 1988.

Separate harvest estimates for chinook salmon less than 41 cm (16 in) were made in 1988 for the first time. These estimates include only small anadromous chinook salmon. Harvest estimates of small chinook salmon taken from stocked lakes are included with data for landlocked coho salmon. Mills (1989) estimates that 464 small anadromous chinook salmon were harvested in the Tanana River drainage in 1988, the majority from the Salcha River.

Coho Salmon:

Anadromous coho salmon are taken in the Delta Clearwater River and from various creeks in the Nenana River drainage. Coho salmon occur in other clear spring-fed tributaries to the Tanana River but little sport effort has occurred. The Kantishna River and Toklat River tributaries such as Moose, Barton, and Geiger creeks, and the Sushana River (Figure 2), where artesian waters are found, support coho salmon populations. The largest sport harvest in the Tanana River drainage, occurred in 1988 when an estimated 2,237 coho salmon were taken (Table 2). The majority of the harvest in the Tanana River drainage occurs in the Delta Clearwater River where the coho salmon sport fishery harvest estimate for 1988 was 1,291 fish (Table 1). The fishery in the Delta Clearwater River for coho salmon typically takes place from mid-September until the end of October.

Escapements to the Delta Clearwater River have generally increased since 1985 when 5,358 coho salmon were estimated in the spawning population. Comparable escapement sizes for 1986, 1987, and 1988 were 10,857, 22,300 and 21,600 fish respectively (Whitmore et al. 1990). Escapement size since 1977 has ranged from 3,946 fish in 1980 to 22,300 fish in 1987. Commercial fishing restrictions in the lower Yukon River salmon fisheries, combined with excellent survival of adult coho salmon have apparently favored large escapements of this species to the Yukon and Tanana spawning grounds.

Stocking of landlocked coho salmon in Quartz, Birch, Chena and several smaller lakes has been popular with interior area anglers. More than 32,000 such fish were harvested from stocked lakes in 1988, with 19,000 taken from Quartz Lake alone (Table 1).

Arctic Grayling:

Arctic grayling are a ubiquitous and frequently sought-after sport species in the Tanana Area, inhabiting most of the flowing waters and many of the lakes of the drainage. Trout-like feeding characteristics make the Arctic grayling a favorite of anglers. Essentially all the major clear water tributaries to the Tanana River support Arctic grayling populations. The major Arctic grayling fisheries in the Tanana drainage occur in the Chena, Salcha, Chatanika, and Goodpaster rivers; Badger and Piledriver sloughs; the Delta and Richardson Clearwater rivers; and Fielding and Tangle lakes. The Tangle lakes support the largest lacustrine fishery for Arctic grayling in Alaska.

Table 2. Arctic-Yukon-Kuskokwim Region sport fish harvests by species, 1978-1988[a].

Species	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Chinook Salmon	499	1,095	1,159	1,880	1,875	2,514	3,697	1,819	2,687	2,860	2,193	3,818
Sea-Run Coho Salmon	973	1,447	2,983	3,536	2,132	5,961	5,932	12,036	3,192	8,693	8,441	11,950
Landlocked Coho/ Chinook Salmon	7,151	22,412	36,073	25,733	57,294	43,374	34,255	29,245	41,042	24,061	26,624	32,342
Sockeye Salmon	69	85	126	112	117	430	261	650	169	439	1,364	1,528
Kokanee Salmon	0	0	0	0	0	0	0	0	0	0	0	0
Pink Salmon	2,524	8,328	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404	1,322	3,859
Chum Salmon	1,246	1,992	1,701	2,773	3,640	5,781	4,698	3,274	3,036	4,336	2,768	3,692
Steelhead	0	0	0	0	0	0	0	0	0	0	0	0
Rainbow Trout	6,215	6,768	5,587	20,419	25,553	26,982	22,447	35,477	34,091	31,774	32,416	79,944
Cutthroat Trout	0	0	0	0	0	0	0	0	0	0	0	0
Brook Trout	0	0	0	0	0	0	0	0	0	0	0	0
Lake Trout	2,269	1,100	1,601	2,289	2,821	5,127	4,094	3,624	5,354	3,250	1,113	2,730
Dolly Varden/ Arctic Char	4,908	4,538	8,508	8,797	8,748	14,129	20,617	13,232	14,660	10,373	12,369	12,147
Arctic Grayling	67,168	94,564	89,472	100,546	96,180	108,796	123,163	99,142	81,226	65,725	57,956	68,961
Northern Pike	11,661	11,753	11,979	15,642	15,125	17,257	18,834	14,217	15,703	18,996	14,222	19,824
Whitefish	4,154	7,482	6,014	7,692	5,449	12,351	13,057	11,892	20,860	31,770	27,159	13,630
Burbot	1,773	1,889	2,097	3,363	4,806	5,783	5,595	5,933	5,215	5,611	4,017	3,878
Sheefish	1,247	1,291	1,542	2,411	2,239	3,281	3,323	3,947	2,520	3,721	2,597	3,221
Smelt	0	0	0	0	0	0	0	0	8,750	464	7,080	2,476
Halibut	0	0	0	0	0	0	0	0	62	0	36	0
Rockfish	0	0	0	0	0	0	0	0	0	0	0	0
Razor Clams	0	0	0	0	0	0	0	0	0	0	0	0
Other Fish	3,214	1,293	2,297	3,513	3,232	8,561	8,827	1,883	1,336	1,349	0	371
Total	115,071	166,037	174,057	206,550	232,329	274,541	274,086	245,083	241,109	216,826	201,677	264,371

[a] From Mills 1989

Table 2. (page 2 of 3).

Species	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AYK Region (both management areas):											
Chinook Salmon	1,095	1,159	1,880	1,875	2,514	3,697	1,819	2,687	2,860	2,193	3,818
Sea-Run Coho Salmon	1,447	2,983	3,536	2,132	5,961	5,932	12,036	3,192	8,693	8,441	11,950
Landlocked Coho/ Chinook Salmon	22,412	36,073	25,733	57,294	43,374	34,255	29,245	41,042	24,061	26,624	32,342
Sockeye Salmon	85	126	112	117	430	261	650	169	439	1,364	1,528
Pink Salmon	8,328	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404	1,322	3,859
Chum Salmon	1,992	1,701	2,773	3,640	5,781	4,698	3,274	3,036	4,336	2,768	3,692
Rainbow Trout	6,768	5,587	20,419	25,553	26,982	22,447	35,477	34,091	31,774	32,416	79,944
Lake Trout	1,100	1,601	2,289	2,821	5,127	4,094	3,624	5,354	3,250	1,113	2,730
Dolly Varden/ Arctic Char	4,538	8,508	8,797	8,748	14,129	20,617	13,232	14,660	10,373	12,369	12,147
Arctic Grayling	94,564	89,472	100,546	96,180	108,796	123,163	99,142	81,226	65,725	57,956	68,961
Northern Pike	11,753	11,979	15,642	15,125	17,257	18,834	14,217	15,703	18,996	14,222	19,824
Whitefish	7,482	6,014	7,692	5,449	12,351	13,057	11,892	20,860	31,770	27,159	13,630
Burbot	1,889	2,097	3,363	4,806	5,783	5,595	5,933	5,215	5,611	4,017	3,878
Sheefish	1,291	1,542	2,411	2,239	3,281	3,323	3,947	2,520	3,721	2,597	3,221
Smelt	0	0	0	0	0	0	0	8,750	464	7,080	2,476
Halibut	0	0	0	0	0	0	0	62	0	36	0
Other Fish	1,293	2,297	3,513	3,232	8,561	8,827	1,883	1,336	1,349	0	371
Total	166,037	174,057	206,550	232,329	274,541	274,086	245,083	241,109	216,826	201,677	264,371

[a] From Mills 1988

Table 2. (page 3 of 3).

Species	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
AYK Area:											
Chinook Salmon	932	644	939	1,112	1,530	2,649	1,481	1,331	2,079	1,691	2,965
Sea-Run Coho Salmon	1,308	2,958	3,469	2,087	5,909	5,785	11,205	2,396	7,319	7,210	9,713
Landlocked Coho/ Chinook Salmon	0	0	0	0	0	0	0	0	0	58	0
Sockeye Salmon	85	126	112	117	430	261	650	169	439	1,364	1,528
Pink Salmon	8,328	2,918	7,844	3,118	14,214	5,286	8,712	1,206	3,404	1,322	3,859
Chum Salmon	1,834	1,482	2,290	3,045	5,083	4,049	2,689	1,781	3,643	2,148	3,201
Rainbow Trout	362	401	835	982	796	1,783	1,455	659	504	592	1,599
Lake Trout	497	655	1,025	1,100	2,023	1,157	1,520	2,370	2,537	461	509
Dolly Varden/ Arctic Char	4,014	8,144	8,273	8,176	13,647	20,324	12,882	13,430	10,173	12,333	11,238
Arctic Grayling	11,289	19,229	20,396	20,892	27,043	30,800	15,516	17,666	19,744	19,476	16,302
Northern Pike	3,915	4,004	6,190	5,184	7,435	8,609	4,610	3,613	7,062	4,751	7,838
Whitefish	909	855	1,705	576	3,708	4,746	234	630	4,960	724	1,855
Burbot	506	118	663	684	1,896	555	377	420	469	162	145
Sheefish	1,057	1,263	2,315	2,146	3,154	3,166	3,609	2,100	3,649	2,362	2,239
Smelt	0	0	0	0	0	0	0	8,750	464	7,080	2,476
Halibut	0	0	0	0	0	0	0	62	0	36	0
Other Fish	1,212	2,218	3,513	3,124	8,551	8,806	1,844	1,336	1,178	0	371
Total	36,248	45,015	59,569	52,343	95,419	97,976	66,784	57,919	67,624	61,770	65,838

[a] From Mills 1988

Historically, the Chena River has supported the largest Arctic grayling fishery in the state, due to its proximity to Fairbanks and many miles of road access. The average annual harvest of Arctic grayling in the Chena River, exceeded 21,000 fish from 1977 to 1984. The harvest declined from a peak of 42,000 in 1980 to a low of 3,090 in 1987. In 1988 the estimated sport harvest of Arctic grayling from the Chena River and its tributaries was 5,328 fish (Table 1), an increase of approximately 42% over the 1987 harvest estimate. Clark (1987) attributes declines in abundance and fishing success in the Chena River to both sport fishing overharvest and to reduced recruitment because of unfavorable environmental conditions (primarily high river discharge during the natal year).

Declines in important Tanana River drainage Arctic grayling fisheries have been noted in recent years and Shaw Creek, the Delta Clearwater River, Richardson Clearwater River and Chena River fisheries are examples of depleted stocks. In 1975, because of increased fishing effort associated with the influx of people for the construction of the trans-Alaska pipeline, the daily bag limit in the Tanana drainage was decreased from 10 to five Arctic grayling. The reduction in bag limit in 1975 to five fish daily and 10 in possession did not prevent the decline of important Arctic grayling stocks nor did it increase or stabilize fishing success. Further restrictions were enacted in 1987, among these was a decrease in the possession limit to five Arctic grayling daily, corresponding to the daily bag limit.

In spite of large historic annual harvests in the Tanana Area, there have been no trophy Arctic grayling (larger than 1.4 kg, 3.0 lb) registered since the inception of the trophy program in the mid-1960's, while 102 individuals have been recorded from rest of the state. Growth rates of individual Arctic grayling in the Tanana River drainage are considered to be typical for Alaska, however, growth rates of Arctic grayling in Bristol Bay, and the Seward Peninsula, where the majority of the trophy fish have been taken, are exceptionally high. It is also possible that Tanana River drainage populations have been maintained at smaller individual size from steady fishing and natural mortality, so that even though growth rates are normal, larger individuals are removed before reaching minimum trophy size.

Northern Pike:

Northern pike are harvested by sport fishermen using hook and line gear in summer and winter as well as with spears during the winter. The majority of the Tanana Area harvest comes from lakes that have relatively good access. Important fishing areas are found in Minto Flats, northwest of Fairbanks (Figure 2) and in Harding, George and Volkmar lakes (Figure 3). Through-the-ice fisheries that occur during the two months just prior to spring break-up, during the period when northern pike have gathered into spawning concentrations, accounts for a significant portion of the annual fishing mortality.

In 1988, the sport harvest of northern pike in Harding Lake, Minto Flats and George Lake was 2,092, 1,128 and 1,837 fish respectively, accounting for more than 42% of the harvest of 11,986 northern pike in the Tanana River drainage (Table 1).

Additional lakes and streams utilized by sportsmen for this species include East and West Twin lakes and Wien Lake in the Kantishna River drainage, Fish Lake near the Tanana-Yukon confluence, Wellesley, Dog, Jatahmund, Island, and Deadman lakes, Moose and Scotty creeks in the vicinity of Northway (Figures 2 and 6), and other tributary streams of the lower Tanana River.

Harvest and effort have increased for northern pike in the past ten years. Angler surveys indicate that this species is the second most sought-after indigenous sport fish species in interior Alaska, and it is estimated that more than 20,000 anglers fished for northern pike in the Tanana Area during 1986 (Holmes and Pearse 1987). The total sport harvest of northern pike within the Tanana River drainage has remained relatively stable over the past ten years, from 8,000 to 12,000 fish annually although the distribution of the harvest has varied among various fishing sites. Because of the substantial increase in effort, however, the catch per angler day has decreased, and some stocks have been overfished.

Recent studies of northern pike populations within the Tanana River drainage have found that exploitation rates are higher than sustainable in some populations. Even in populations where exploitation rates are not judged to be excessive (less than 20% per year) as in Volkmar Lake, the number of large fish has declined under only moderate harvest pressure. The Minto Flats population has been of special concern due to high additive estimated rates of exploitation in summer and winter subsistence and sport fisheries. Concern for increased harvest in the Minto Flats (Tolovana River drainage) resulted in a winter closure of the sport fishery beginning in the winter of 1987. Northern pike were found in low densities in Minto Flats in 1988. Burkholder (1989) reported about four fish (greater than 299 mm in fork length) per hectare in the Minto Flats area in 1987 and 1988. Apparent exploitation rates were as high as 30% in recent years in the Minto Flats area, but new regulations, including a reduction in the daily bag limit from 10 to five fish and a winter sport fishery closure, helped reduce harvest to about 1,500 northern pike in 1988. Historical harvests from this wetlands complex were much higher, with estimates exceeding 4,600 and 4,900 northern pike in 1985 and 1986. A total of 56 (38%) of the statewide registered trophy northern pike (minimum weight of 6.8 kg, 15 lbs) was taken from the Tanana River drainage. The Chatanika River, Tolovana River and Minto Flats (considered parts of the Minto Flats complex) account for 23 (41%) of the Tanana River drainage trophy northern pike records, with 12 (21%) from East Twin Lake and 8 (14%) from Volkmar Lake. The number of large pike taken from each area may be more reflective of relative amounts of fishing effort than of size and growth characteristics of the respective stock.

Lake Trout:

Lake trout are found in many of the lakes and some streams of the Delta and upper Tanana River drainages (Burr 1987a). They are most frequently associated with deep, oligotrophic lakes in the mountains and are rarely found at lower elevations of the Tanana River drainage. Lakes of the Delta River drainage (Figure 5) including Fielding, Landmark Gap, Glacier, Sevenmile, and the Tangle lakes contain lake trout. Transplanted lake trout occur in Harding

Lake (Figure 4) near Fairbanks and although the small numbers do not support a substantial fishery, some large individuals have been taken. On average, 65% of the AYK Region lake trout harvest is taken from lakes in the Tanana drainage. The regional lake trout harvest increased at an annual average rate of 27% from 1978 to 1985. An apparent major decline in abundance occurred and was first observed in 1986 in waters of the Tanana drainage. Research in both southcentral and interior Alaska indicates that most of the road accessible stocks have undergone overexploitation in recent years.

Lake trout are a long lived, slow growing and late maturing species, and the potential impact of even a modest fishery can be significant. Lake trout older than 25 years are not uncommon and individuals older than 50 years are recorded for Alaska (Burr 1987a). Trophy lake trout weighing 8.7 kg (20 lbs) or more are typically 20 or more years old (Burr 1987). Lake trout residing in high elevation lakes in the Alaska Range migrate into shallow rocky shoals to spawn in late fall. Lake trout spawn for the first time at ages ranging from 5 to 12 years of age, depending on growth conditions primarily, and spawning in alternate years instead of every year may be normal in interior and northern Alaska.

Estimated harvest of lake trout in the Tanana River drainage peaked at about 3,100 fish in 1982. Harvest declined to 713 and 652 in 1986 and 1987, after a reduction in the bag limit from 12 to two lake trout per day had been enacted (Table 2). After two years of reduced harvest, Mills (1989) estimated that the 1988 harvest of lake trout had increased to 2,221 fish (Table 1). However, further investigation of responses to the statewide harvest survey showed that harvests of lake trout were reported from lakes known to contain only stocked rainbow trout and/or Arctic char, particularly from those lakes on Eielson Air Force and Fort Greely Army bases. The more accurate estimate of 1988 native lake trout in the Tanana River drainage is 783 fish.

Five trophy lake trout are recorded from the Tanana Area, three taken in Harding Lake, one each in Fielding and Upper Tangle lakes.

Burbot:

Burbot fishing has become increasingly popular with Alaskan anglers in recent years. The majority of the AYK Region harvest occurs in waters of the Tanana Area. Participation is mostly by local residents using set lines although hand-held fishing gear is also used. Most fishing in the Tanana River near Fairbanks occurs during the winter months while in the upper Tanana River drainage, a major portion of the annual harvest occurs in spring and summer. Burbot fishing occurs in streams, such as the Tanana, Chena and Tolovana rivers, and in lakes. In past years, the most heavily fished lakes were Fielding, Harding, and Tangle lakes. Since 1987, bag limits in these lakes were reduced to two fish daily, and use of set lines was eliminated. The Tanana River supports one of the largest burbot fisheries in the state, surpassed only by the burbot fisheries in and around the Glennallen area. Although Tanana River burbot harvest rates are not considered to be excessive, studies of harvest rates and abundance in lakes of the drainage suggest high exploitation and low stock abundance in most of the lakes examined. Population density of burbot in lakes declined dramatically in the early

1980's due to unsustainable rates of sport fishing exploitation. Research that has taken place for five years on Fielding Lake for example, indicates only modest recovery of the population, even with minimum fishing pressure (Parker et al. 1989). Burbot stocks in the Tanana River are generally exploited near population centers such as Fairbanks, Delta Junction, and near Northway. Movements of burbot in the Tanana River tend to minimize effects of concentrated local fishing effort, and stocks in the Tanana River appear to be lightly exploited (Evenson 1989).

To prevent further declines in burbot populations in lakes of the Tanana drainage, the Department implemented emergency regulations in 1987 to prohibit the use of set lines from May 15 to October 15, and to reduce the bag and possession limit in all Tanana drainage lakes to five fish. Also, a ban on the use of set lines throughout the entire year was enacted for Harding, Fielding, T, and Tangle lakes along with a further reduction in the bag and possession to two burbot in these waters. The estimated harvest of burbot in the Tanana River drainage by sport anglers in 1988 was 3,733 fish, similar to the 1987 harvest estimate (Table 2).

Of the 139 trophy burbot registered in Alaska, (minimum size 3.6 kg, 8 lbs) 78 (56%) were taken in the Tanana Area, and the majority of those were taken near Fairbanks in the Tanana (53, 38%) and Chena (20, 14%) rivers.

Whitefish:

Most (60%) of the statewide recreational whitefish harvest occurs in the AYK Region. The sport harvest of whitefish is almost entirely from the Chatanika River, tributary to the Tolovana River, itself a tributary of the Tanana River, where an active spear fishery occurs in the fall. Elsewhere, anglers drift small baited hooks along the stream bottoms in attempting to take whitefish using hook and line techniques.

In 1987, the total harvest of whitefish in the Tanana River drainage was estimated to be about 27,000 fish, with more than 25,000 taken from the Chatanika River (Mills 1988). A total of 11,775 whitefish of all species was harvested in the Tanana Area in 1988. The estimated 1988 harvest of whitefish in the Chatanika River was 7,983 (Table 1) with 56% of the harvest composed of least cisco, and 44% composed of humpback whitefish.

The Chatanika River supports spawning populations of both humpback whitefish and least cisco. During late summer and fall, these fish migrate upstream from Minto Flats to spawn. By freeze-up in approximately mid-October, the adult whitefish have departed for wintering areas that are as yet unidentified, and which may be located downstream of the Chatanika River. It is not known whether the Chatanika River itself is an important habitat for whitefish other than during spawning and the egg-fry development stages.

Harvest levels have increased steadily since 1981 when the total estimated harvest was approximately 5,000 whitefish. Since 1977, harvest of whitefish from the Chatanika River has increased at an average annual rate of 34%, making it the fastest growing recreational fishery in the Tanana River drainage (Hallberg and Holmes 1987). Approximately 3,974 angler-hours of

effort were expended to spear whitefish in 1988. The estimated exploitation rate of humpback whitefish in 1988 was 9.0%. Prior to 1987 no bag or possession limits were in effect for whitefish in the AYK Region A daily limit of 15 whitefish for the waters of the Tanana River drainage was enacted in 1987 and went into effect in 1988. It was hoped that the new regulations would have the effect of not only reducing harvest but also that exploitation rates would be limited to no more than 20%, a level thought to be sustainable for these species.

Sheefish:

Spawning stocks of sheefish in the Tanana River drainage have been documented only in the upper Chatanika River, (Alt 1987). Tagging studies conducted between 1967 and 1971 indicated that sheefish that spawned in the Chatanika River were the same fish that spent the summer feeding in Minto Flats (Alt 1987). Recaptures in the lower Chena River and at Nenana, of fish that were tagged in the Chatanika River, showed that sheefish disperse widely in the areas adjacent to spawning. Sheefish are widely distributed in the Tanana River drainage during the open water season, from the Tanana River mouth to more than 300 km upstream of Fairbanks. They have also been found at the mouths of the Bearpaw and Toklat rivers in the Kantishna River drainage. Typically sheefish are taken in the lower reaches of clear water tributaries such as the Chena, Chatanika, Tolovana, and Tatalina rivers as well as others. Total sport harvest of sheefish in the Tanana River drainage in 1988 was estimated to be 982 fish (Table 1).

Attempts to stock lakes with sheefish in the Tanana drainage to create new sport fisheries met with little success. Harding Lake was stocked nearly annually since 1982 (with the exception of 1984). No returns to the sport fishery have been documented since the inception of stocking. However, good growth and survival of stocked sheefish was reported from Four Mile Lake (Figure 3) along the Taylor Highway from stocking events in 1968 and 1969 (Alt 1981) The appearance of new age classes led Peckham and Doxey (1983) to believe that natural reproduction had occurred.

Rainbow Trout:

Rainbow trout are not indigenous to the Yukon River drainage but have been introduced in several locations, including about 75 Tanana Area lakes since the 1950's. There is no evidence that natural reproduction has taken place.

Piledriver Slough was stocked with 79,481 rainbow trout in 1988. The slough was formerly connected to the Tanana River and is located about 30 km south of Fairbanks (Figure 2). Water in the slough became clear when the Army Corps of Engineers blocked Tanana River water from entering the upper end at several locations in 1976. The slough was blocked in conjunction with the Army Corps of Engineers Chena Flood Control Project, for the purpose of preventing spillage of high water discharge from the Tanana River into the floodway channel during construction. The temporary dikes put in place at that time are still present, although they have not been maintained. Piledriver Slough, fed by groundwater from the Tanana River valley, re-established itself as a water tributary to Moose Creek which discharges directly into the Tanana

River. Arctic grayling, whitefish and suckers were found inhabiting Piledriver Slough within a year after its upper end was blocked. Piledriver Slough was first stocked in 1987 with 35,000 fingerling, 12,500 sub-catchable, and 12,500 catchable size rainbow trout. The objective of stocking was to create a consumptive stream rainbow trout fishery in Alaska's interior, thus providing more diversity in angling opportunity for interior anglers. This was the first documented time rainbow trout had been released into flowing waters in interior Alaska since statehood.

The harvest of rainbow trout in Piledriver Slough by sport anglers in 1988 was estimated to be 12,296 fish, while approximately 78,000 rainbow trout were taken in the Tanana Area including Piledriver Slough (Table 1). Angler effort (number of days fishing) on Piledriver Slough in 1988 exceeded 24,000, the largest amount of effort for any single water body in the Tanana Area (Table 1). Thus Piledriver Slough supported the largest fishery in interior Alaska one year after being stocked with rainbow trout.

Substantial harvests of rainbow trout occur in Birch, Chena, and Quartz lakes in addition to those occurring in Piledriver Slough. The largest harvest occurred in Quartz Lake, where an estimated 25,175 rainbow trout were taken (Table 1). The Tanana Area harvest of rainbow trout in 1988 represented an historical high value, exceeding the 1987 harvest by more than double (Table 2). The steady rise in harvest of this species reflects the successful expansion of the stocking program in the Tanana River valley.

Trophy rainbow trout (minimum size 6.8 kg, 15 lbs) have not been recorded from interior Alaska streams or lakes, and most of the registered trophy fish are native anadromous rainbow trout (steelhead) taken in coastal streams. Nevertheless, good growth rates and size have been achieved in some enhanced lake situations. The largest rainbow trout recorded in the Tanana Area was taken in 1980 from Quartz Lake. It reached a size of 4.5 kg (9.8 lbs). Rainbow trout exceeding 2.3 kg (5 lbs) are commonly taken from area lakes.

ARCTIC, YUKON, AND KUSKOKWIM AREA DESCRIPTION

Excluding the Tanana River drainage which comprises a little over 10% of the land area of the AYK Region, the AYK Area consists of some 870,000 km^2 (58% of the entire land area of Alaska) of extremely varied topography, climate, and zoogeography. Land ownership and jurisdictions fragment this huge area into a complex mosaic. The federal government is the major land manager through its jurisdiction over the land withdrawals for National Parks and Preserves, National Wildlife Refuges, and Wild and Scenic Rivers. Native corporations, State of Alaska and private lands comprise the rest. The State of Alaska, by virtue of the Statehood Act retains authority to manage fisheries and wildlife on all lands and waters of the state. For purposes of reporting and organizing statistics in the statewide harvest survey (SWHS), the AYK Area is subdivided into five sub-areas; Lower Yukon-Kuskokwim, Seward Peninsula-Norton Sound, Northwest Alaska, South Slope of the Brooks Range, and North Slope of the Brooks Range (Figure 1).

Geographic and Geologic Setting

Dominant features of the huge landmass that lies north of the Alaska Range divide include the Alaska Range itself which provides water for streams in the Kuskokwim drainage and to the Tanana River and its tributaries. The Brooks Range and its drainages provide water to the Noatak, Kobuk, Colville, Koyukuk, and Porcupine rivers as well as to many other streams that drain directly into the Yukon River or the Arctic Ocean and the Chukchi Sea.

The Yukon is the largest river in Alaska and its drainage constitutes the fifth largest in North America. The river originates in the basin and range domain of the southern Yukon Territories and northern British Columbia, and flows over 3,700 km northwest to its mouth on the Bering Sea coast. Additional Canadian flows to the upper Yukon River watershed are added from glacial streams such as the White River which originates in the Wrangell and St. Elias Mountain ranges. Approximately one-third of the Yukon River watershed is in Canada. The total drainage area of the Yukon River is approximately 855,000 km^2, including the area in Canada. Approximately three-fourths of the land area of the AYK Region is encompassed in the Yukon River drainage. The entire mainstem of the Yukon River up to the confluence of the White River (Figure 8) in Canada is turbid from glacial silt entrained in the waters draining the Alaska, St. Elias, and Wrangell Mountain ranges.

Lake and Stream Resources

Sport fishing waters and opportunities are extremely varied as could be expected in an area so large and diverse. In the following section the primary fishing waters and species of interest will be briefly characterized for each of the five sub-areas within the AYK Area. It is recognized that not all streams, lakes, or fish stocks of importance receive attention in this cursory treatment.

Lower Yukon and Kuskokwim River Sub-area:

The lower Yukon-Kuskokwim sub-area (statewide harvest Area V; Figure 1) includes all southern drainages of the Yukon River from its confluence with the Tanana River, near Tanana, west to Kaltag; all north and south drainages of the Yukon River south of Kaltag to the Bering Sea; the Kuskokwim River watershed; all waters flowing into Kuskokwim Bay; and adjacent salt water and islands. The sub-area has also been referred to as the Interior sub-area in some reports. This sub-area does not include the Pastolik River drainage and waters flowing into Norton Sound northeast of the Pastolik River nor any portion of the Tanana River watershed[1]. The Lower Yukon-Kuskokwim sub-area excludes the Koyukuk and Porcupine River drainages because they drain the south slope of the Brooks Range. It should also be noted that prior to 1984 the boundaries of the sub-area were such that the Arctic Circle was utilized as a northern limit. Now the northern limit of the Lower Yukon-Kuskokwim sub-

[1] The Sport Fish Division assigns management responsibility for Kuskokwim Bay and Kuskokwim River waters upstream to Aniak to its Southcentral Region headquartered in Anchorage. Responsibility for these areas is assigned to Sport Fisheries staff stationed in Dillingham.

area extends from Kaltag along the Yukon River to the confluence with the Tanana River (Mills 1985).

The primary flowing waters of the sub-area are the mainstems of the Yukon and Kuskokwim rivers and their tributaries. The Holitna River is the most productive stream for sport fishing in the Kuskokwim River drainage (Figure 9) above the Aniak River confluence, because of the diversity and abundance of its resident and anadromous species. Approximately six fishing guides provide services on the river to about 75 clients per year (Rue et al. 1987). No permanent lodge or tourist structures are present on the river. The Holitna River supports populations of Arctic char *Salvelinus alpinus*, Dolly Varden *Salvelinus malma*, Arctic grayling, northern pike, burbot, sheefish, various whitefish species and all five pacific salmon species. Rainbow trout do not occur in the Kuskokwim River drainage upstream of the Aniak River. Dolly Varden, coho salmon, and chinook salmon are the primary sport fish species in the Holitna River, although feeding sheefish are present in the summer as far upstream as the Hoholitna River (Alt 1987) and are sought by some anglers. The Stony, Swift, Gagaryah, Tatlawiksuk, Cheeneetnuk, and Hoholitna rivers are some of the other important middle Kuskokwim River tributaries. All originate in the Alaska Range and its foothills (Figure 9). Fishery resources of these streams are incompletely documented, and because of remoteness and limited access, they are thought to receive only light recreational use from sport anglers.

Upstream of McGrath, (Figure 10) in the upper Kuskokwim drainage, there are many tributaries that originate in the Alaska Range, such as the Big River, the Middle, South, Windy, Big Salmon, Slow, and East forks of the Kuskokwim River, as well as the Tonsona and Little Tonsona rivers and Highpower Creek near Telida. The North Fork, Nixon Fork, and Takotna rivers originate in the Kuskokwim Mountains west of the Kuskokwim River. Chinook, coho, and chum salmon *Oncorhyncus keta* spawn in streams of the upper Kuskokwim drainage, as do sheefish. Sheefish spawning has been documented in Big River and in Highpower Creek (Alt 1987). Although most of the primary sport fish species occur in the middle and upper Kuskokwim River drainage, (with the exception of rainbow trout), sport fishing effort is extremely light on most streams and fish stocks. Most fishing exploitation in the middle and upper part of the drainage occurs in local subsistence fisheries that mainly target salmon and whitefish.

Lake development in the Kuskokwim River drainage above the Aniak River is sparse, and there are few documented lakes with high potential for recreational fisheries. The fisheries resources in two lakes (Telequana and Two; Figure 9) in the upper Stony River were surveyed by Russell (1980), and Whitefish Lake in the upper Hoholitna River was surveyed in 1977 by Baxter (1977). Lake trout, Arctic grayling, northern pike, and various whitefish species were present in all lakes surveyed. Dolly Varden were noted in Two and Telequana lakes but not in Whitefish Lake. Recreational angling occurs in Telequana and Two lakes, both by guided and unguided fishermen. Little information is available regarding sport fishing opportunities and species available in other lakes of the drainage. Most of the lakes in the upper drainage are shallow tundra lakes, unsuitable for supporting year-round resident fish populations. Big Lake near Sleetmute, and Tundra and Trout

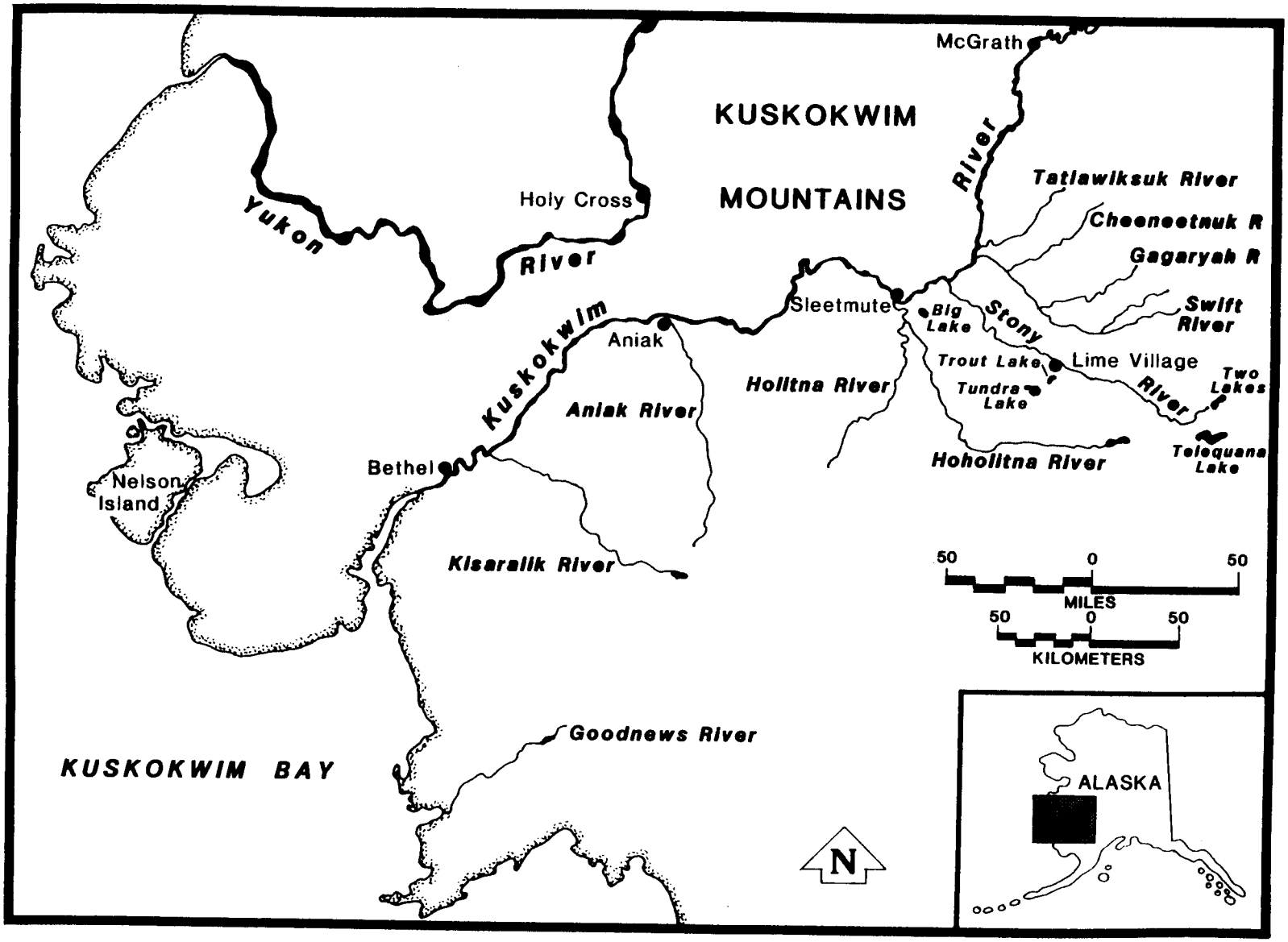

Figure 9. Waters of the lower Kuskokwim River valley.

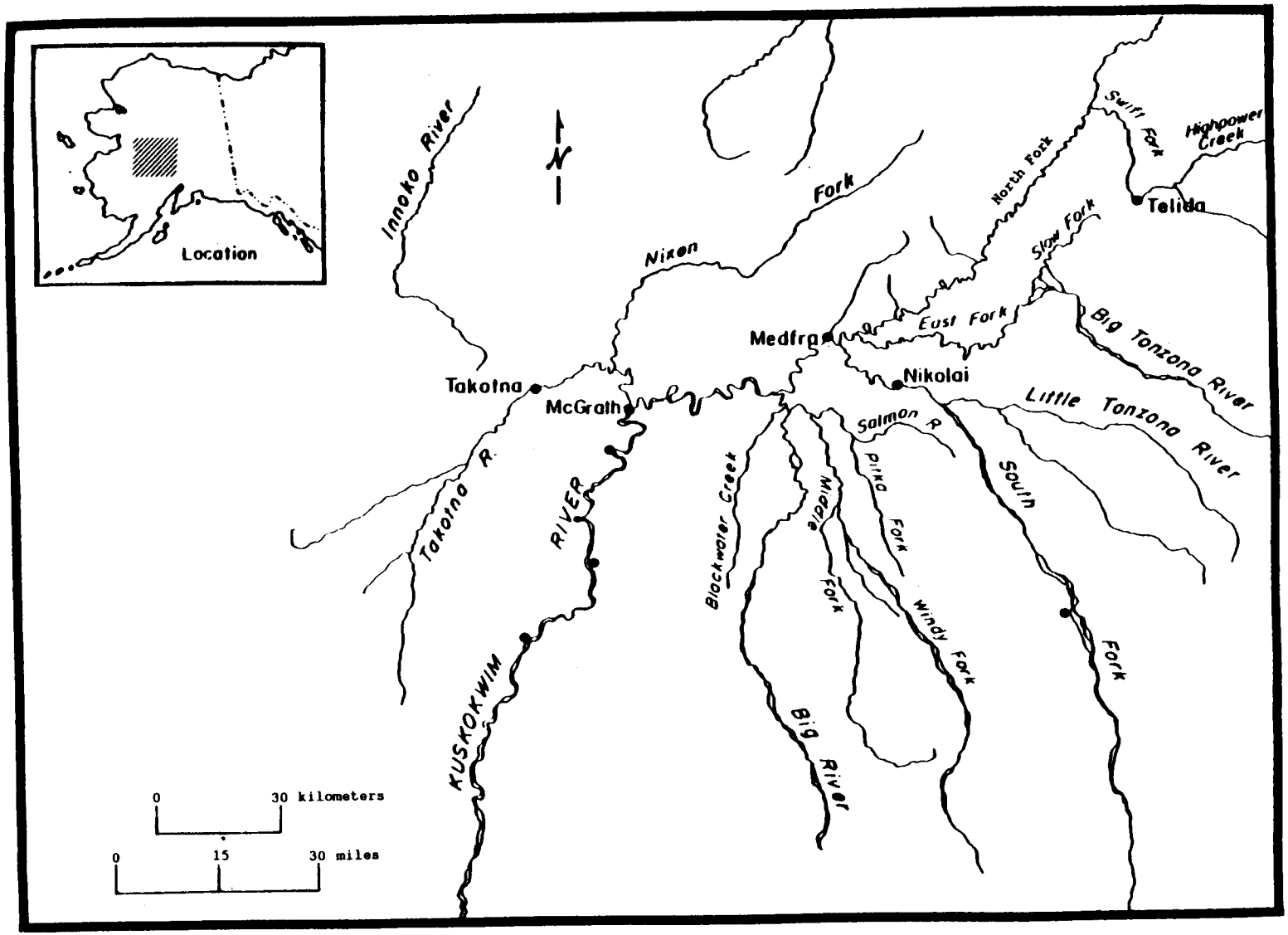

Figure 10. Waters of the upper Kuskokwim River valley.

lakes near Lime Village on the Stony River support year-round fish populations because of their size.

Clear water streams with sport fishing potential that are part of the Yukon River drainage are extremely numerous and extend to third and fourth order tributaries. Although the main stem of the river flows for approximately 3,200 km, (with the upper third in Canada) this report includes only Alaskan waters. Beginning near the Yukon River mouth, (Figure 11) the east and west forks of the Andreafsky River are both high quality sport fishing streams and have been designated as Wild and Scenic Rivers (Wild and Scenic Rivers Act 1968; ANILCA 1980). All the Pacific salmon species, with the exception of sockeye salmon *Oncorhynchus nerka*, occur in the rivers as do Arctic grayling, Dolly Varden, and northern pike (in sloughs and lakes off the rivers). Each fork of the Andreafsky River is in itself a major stream and both drain extensive remote areas of the Nulato Hills between the Yukon River Delta and Norton Sound.

The lower Yukon River provides a migratory corridor for all the species of resident, anadromous, and semi-anadromous fishes of the drainage. In addition, many species, such as sheefish, northern pike, several whitefish species, burbot and longnose suckers utilize the mainstem lower river for rearing and feeding, particularly in winter months. For some species such as burbot, the mainstem provides year-round habitat.

The Innoko River and its tributaries drain a large area of flat wetlands and foothills of the Kuskokwim Mountains. The confluence of the Innoko River with the Yukon River is near the village of Holy Cross. The Innoko River system contains numerous northern pike and whitefish as well as other species. A small sockeye salmon stock may spawn in the system, in addition to chum, chinook and coho salmon, but there is no evidence that the Innoko River is important for salmon production when compared to other known productive streams in the Yukon River drainage.

The Anvik River, which enters the Yukon River near the village of Anvik about 515 km upstream from the mouth, is a highly productive stream. The river courses eastward from its drainage area in the Nulato Hills for about 130 km and although it is primarily a rapid runoff stream, artesian upwelling helps stabilize winter flows and water temperatures. Besides supporting the largest chum salmon spawning stock in the Yukon River drainage, with over a million individuals spawning in some years (Whitmore et al. 1987), the stream supports large numbers of chinook and coho salmon, Arctic grayling, Dolly Varden, and some northern pike. Fishing quality is excellent, but few anglers use the stream during the summer season because of its remoteness and difficult access.

The Kaltag and Rodo river mouths, and Bishop Creek mouth support sheefish and Arctic grayling fisheries during summer and early fall months. Sport fishing for northern pike is common in sloughs and lakes near the main stems of the Yukon and Koyukuk rivers as well as in the extensive Kaiyuh Flats southeast of Galena.

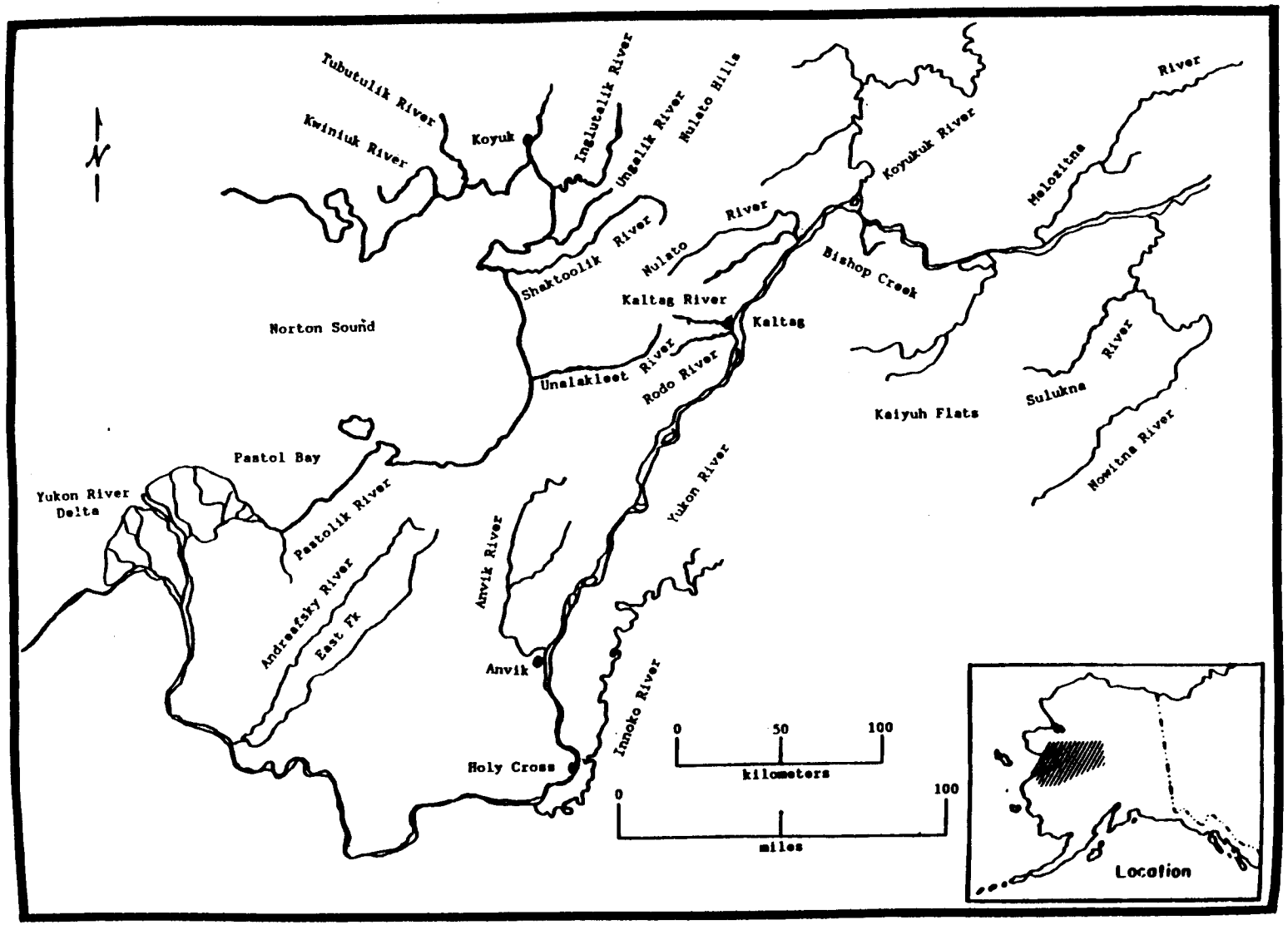

Figure 11. Lower Yukon River and eastern Norton Sound drainages.

The Nowitna River, whose confluence with the Yukon River is upstream from Ruby, is a major clear tributary which enters the Yukon from the south and drains the north slope of the Kuskokwim Mountains. It was designated as a Wild and Scenic River in 1980 (Alaska National Interest Lands Conservation Act, P.L. 96-487), and supports a significant amount of recreational fishing. Most sport fishing is done by Fairbanks residents using personal riverboats or aircraft to reach the river. Good angling for sheefish, northern pike and Arctic grayling can be found in the system, which consists of several branches. Most of the main stem and major tributaries are included in the Nowitna National Wildlife Refuge (USFWS 1987b). Sheefish spawn in the Sulukna River tributary (Alt 1987).

Few lakes of sufficient area or depth to influence winter flow volume or temperature are present in the upper Kuskokwim River drainage or the Alaska Yukon River drainage. The majority of the lakes in the Yukon drainage developed as a consequence of the thawing of saturated permafrost soils and as a result, these lakes are mostly shallow and not supportive of primary sport species such as lake trout. There are thousands of such lakes in the deltas and floodplains of the drainage. Many provide summer feeding and rearing for various whitefish species, as well as for northern pike and occasionally, sheefish. Fish utilizing shallow thaw lakes for summer feeding generally move into primary tributaries and main stems of the major rivers prior to freeze-up in the fall.

Seward Peninsula/Norton Sound:

The Seward Peninsula-Norton Sound sub-area (statewide harvest Area W; Figure 1) includes all waters north of the Yukon River drainage and south of the Selawik River-Kotzebue Sound area and west of the Yukon-Koyukuk River drainages. This area includes Pastol Bay and all salt water north and west of it in Norton Sound as well as salt water adjacent to the Seward Peninsula, including Spafarief Bay in Kotzebue Sound and the southern half of Eschscholtz Bay (ADFG 1984).

Primary sport fishing streams in eastern Norton Sound (Figure 11) include several that drain the Nulato Hills which separate Norton Sound from the Yukon and Koyukuk River valleys. They include the Unalakleet, Shaktoolik, Inglutalik, and Ungalik rivers. The Unalakleet River is the largest and most heavily utilized of these, and it supports a sport fishery during summer months. A permanent lodge is established on the lower Unalakleet River, and guide service is available from it and other sources. The river and its tributaries support populations of Arctic grayling and Dolly Varden as well as chinook and coho salmon. Other area streams also support those species, but are not as intensively fished, primarily because of the limited access and facilities available to non-local fishermen. The Koyuk River main stem carries an abundance of entrained material, including tannic stain, reducing water clarity. The stream terminates in Norton Bay at the extreme eastern corner of Norton Sound. It offers little potential for sport fishing except for northern pike and Arctic grayling in some clear water tributaries.

Several high quality sport fishing streams are located along the southern half of the Seward Peninsula from Koyuk to Teller, (Figure 12) including the

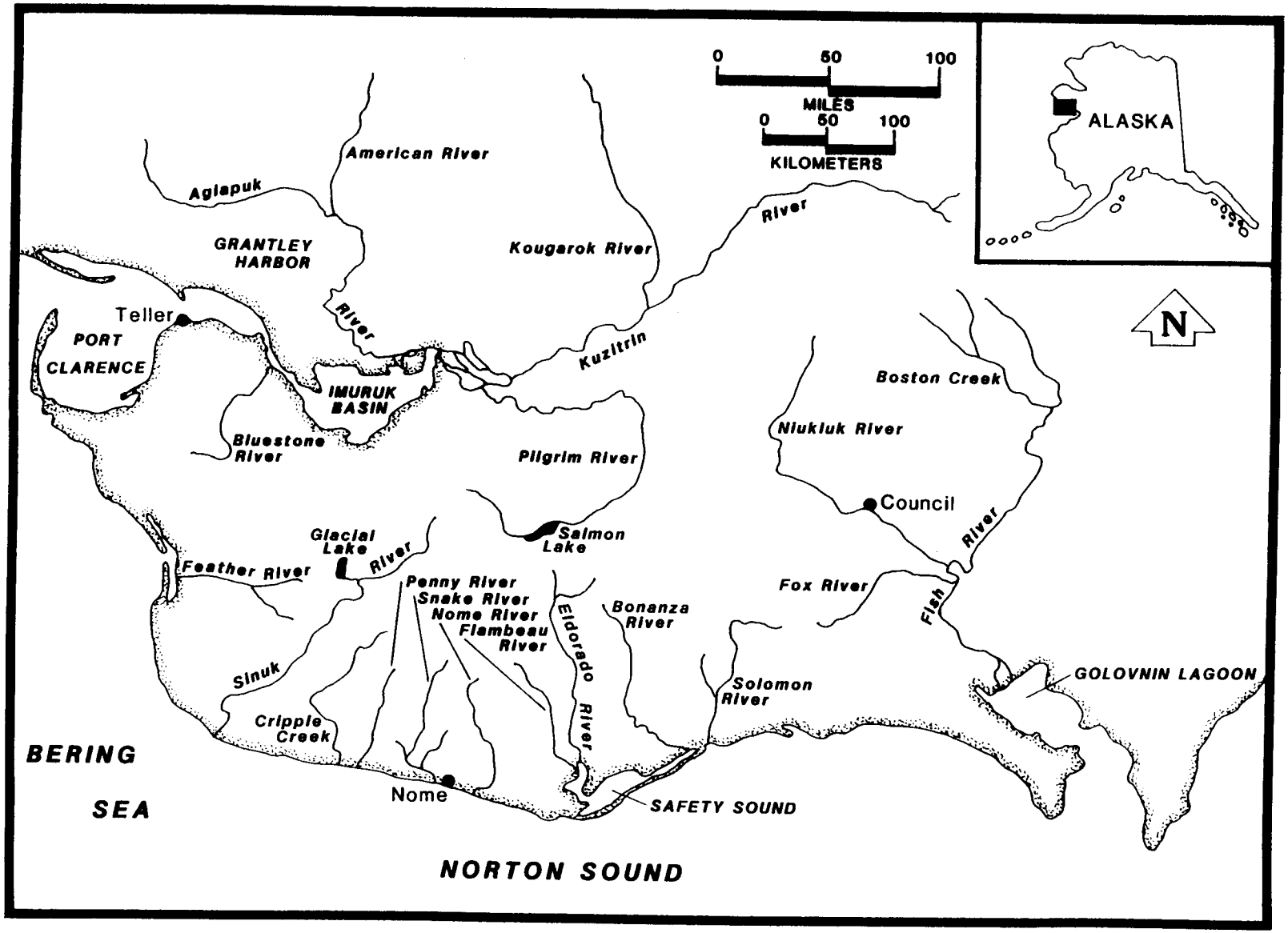

Figure 12. Waters of the Seward Peninsula.

Tubutulik, Kwiniuk, Fish, Niukluk, Bonanza, Eldorado, Nome, Snake, Sinuk, Pilgrim, Agiapuk, and Kuzitrin rivers. Road access from Nome exists to many of these streams. Arctic grayling, Dolly Varden, and coho salmon occur in these streams, and many contain chinook salmon, pink salmon *Oncorhynchus gorbuscha*, chum salmon, burbot or northern pike. Small, perhaps remnant, sockeye salmon stocks are also present in the Pilgrim and Sinuk rivers. Trophy Arctic grayling, larger than 1.4 kg (3 lbs) are present in many streams on the Seward Peninsula, including the Sinuk, Nome, American, Tubutulik, Fish, Pilgrim and Kuzitrin rivers as well as others. Many of the largest Arctic grayling recorded as trophies for Alaska have been taken from streams on the Seward Peninsula. Of the 104 largest fish registered from 1967 to 1988 in the ADFG trophy fish program, 30 were taken in waters of the Seward Peninsula. Twenty-one of the 28 registered trophy Arctic grayling from the Seward Peninsula were taken from the Sinuk River.

Most of the streams draining the northern half of the Seward Peninsula have low sport fishing potential due to relatively small flow volumes, difficult access, and poorer quality of water and fisheries habitat.

Most of the lakes on the Seward Peninsula were created either by thaw action in river floodplains or by glaciers in the mountains of the central and western Seward Peninsula. The largest inland body of water on the peninsula is Imuruk Lake (Figure 13) in the north-central portion of the peninsula. It is approximately 32 km^2 in area, and was probably formed when volcanic lava originating in the nearby area cut off drainage streams causing water to back up into a local depression. The lake presently drains northward through the Inmachuk River. Salmon spawn at the outlet in the fall and the lake supports whitefish and Dolly Varden.

Other lake waters with recreational fishing potential are smaller glacial lakes in the Imuruk Basin watershed and in the Kigluaik Mountains east of Nome. Some contain populations of lake resident Arctic char (Kretsinger 1987) while other lakes and streams in this area contain anadromous Dolly Varden. Salmon Lake, located about 150 km northeast of Nome in the headwaters of the Pilgrim River, contains Dolly Varden, Arctic grayling, round whitefish and a remnant stock of sockeye salmon. Since the lake can be reached by road from the town of Nome, it receives use for sport fishing, and during the first half of the century was an important recreation and fishing area for gold miners in the area. Subsistence fishing for salmon in Salmon Lake has been prohibited for many years because the stock was practically eliminated by early fisheries. Salmon sport fishing in the lake and it's tributaries is presently prohibited.

Northwest Alaska:

The Northwest Alaska Area (statewide harvest Area X; Figure 1) includes all waters and drainages of the Kotzebue area, including drainages of the Selawik, Kobuk, Noatak, Wulik, and Kivalina rivers. The area also includes all salt water in the northern half of Eschscholtz Bay, including the Chamisso Island area and the northern half of Kotzebue Sound to and including Point Hope (ADFG 1984). The eastward limit of the sub-area extends to the Alatna River.

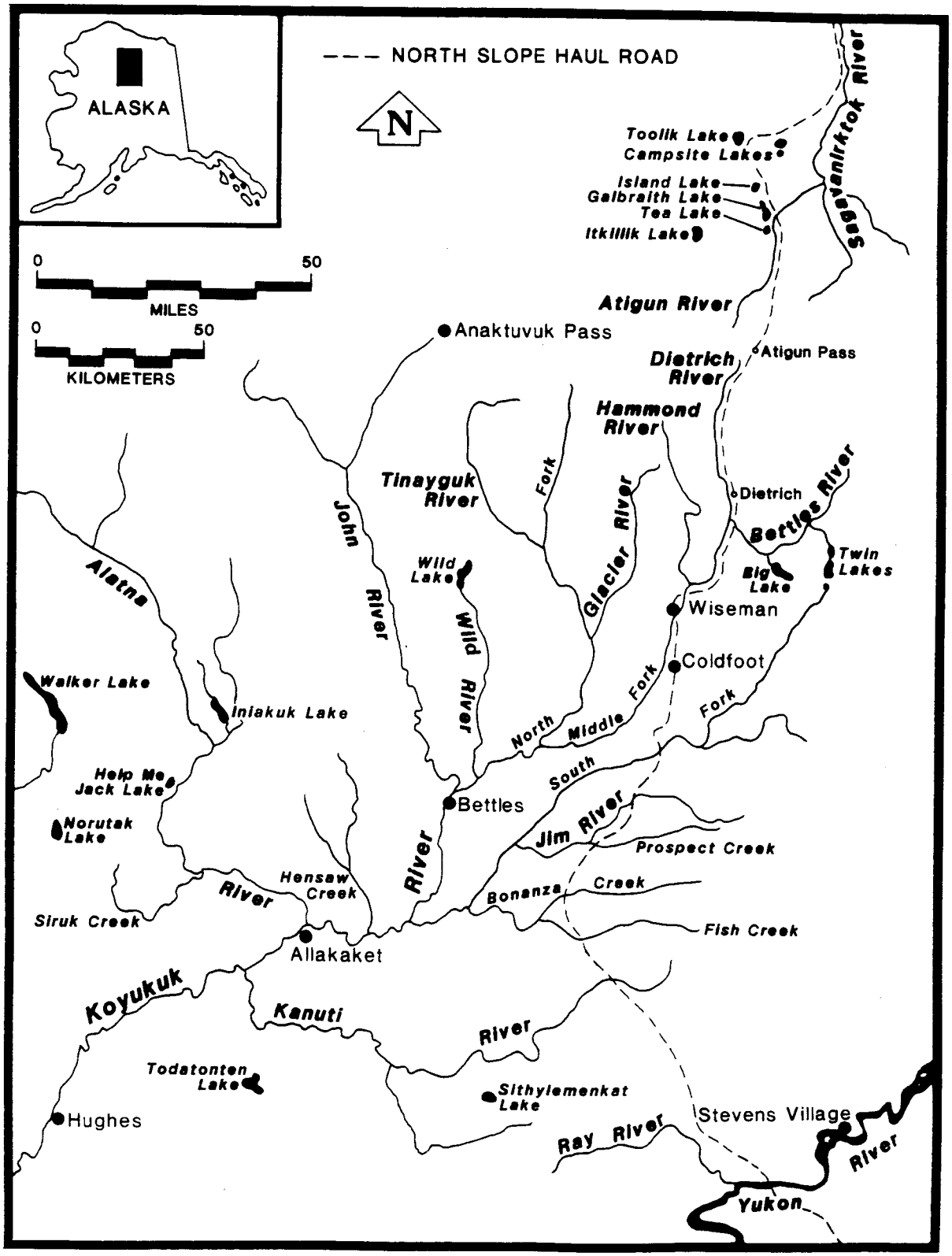

Figure 13. Upper Koyukuk River and North Slope Haul Road.

The most important streams of the Northwest Alaska sub-area (Figures 14, 15 and 16) are the Noatak and Kobuk rivers, both of which drain large areas of the southern slope of the western Brooks Range. Each has a drainage area of approximately 31,000 km^2 and stream length of from 560 km (Kobuk) to 640 km (Noatak; U.S. Army Corps of Engineers 1967). The third largest drainage is that of the Selawik River, with an approximate area of 11,700 km^2. The Noatak River is slightly turbid at most times during the summer months from entrained glacial silt carried from mountain glaciers in the Brooks Range, while waters of the Kobuk and Selawik rivers are more clear. Abundant groundwater resources are found in both the Noatak and Kobuk rivers as water-bearing gravel aquifers on the lower main stem of the Noatak River and in tributaries of the Kobuk River. These aquifers tend to stabilize flows and water temperature fluctuations and provide water storage within the systems.

The Noatak River is designated as a National Wild and Scenic River, and most of the drainage is included in the Noatak National Preserve (Figure 17). The extreme upper headwaters of both the Noatak and Kobuk rivers are included in Gates of the Arctic National Park. A part of the lower Kobuk Valley between Kiana and Ambler is included in the Kobuk National Park, and the Salmon River tributary, as well as the upper main stem of the Kobuk River are National Wild and Scenic Rivers as is the Selawik River. Much of the Selawik River valley is part of the Selawik National Preserve.

These three large river systems contain abundant fisheries resources. The Noatak River produces a large run of late chum salmon that are the primary species for the Kotzebue-based commercial fishery. Many thousands of anadromous Dolly Varden overwinter and spawn in the river. Whitefish and northern pike are resident in the Noatak River. Alt (1987) reports that sheefish use the river for feeding but do not spawn there.

Both the Selawik and Kobuk rivers support spawning populations of sheefish in their upper main stems. The brackish delta systems which have formed at the river mouths serve as overwinter feeding areas for juvenile as well as adult sheefish. Trophy sheefish are taken from these waters especially in the upper Kobuk River during the fall when large mature spawners congregate near spawning areas in the main stem. The Alaska state record sheefish was taken in 1986 from the upper Kobuk River (mouth of the Pah River) and weighed 24 kg (53 lbs). Abundant whitefish utilize the rivers and delta areas, including Selawik Lake and Hotham Inlet (Kobuk Lake). Dolly Varden occur in some tributaries to the Kobuk River, as do northern pike in sloughs and connecting lakes to the lower river. Lake trout inhabit deeper lakes of the upper Kobuk River watershed. The Wulik and Kivalina rivers, which empty into the Chukchi Sea near the village of Kivalina, are well known as trophy streams for Dolly Varden.

Sport fishing effort in Northwest Alaska is relatively light compared to most other areas in the state. Heaviest use occurs on the Noatak, Kobuk, and Wulik rivers. Many visitors to Gates of the Arctic National Park and Kobuk Valley National Park participate in float trips on the Kobuk River from Walker Lake to Kobuk village (Alt 1984; ADFG 1986; NPS 1984, 1985a). A lodge on Walker Lake promotes lake trout and Arctic char fishing. A small amount of shore

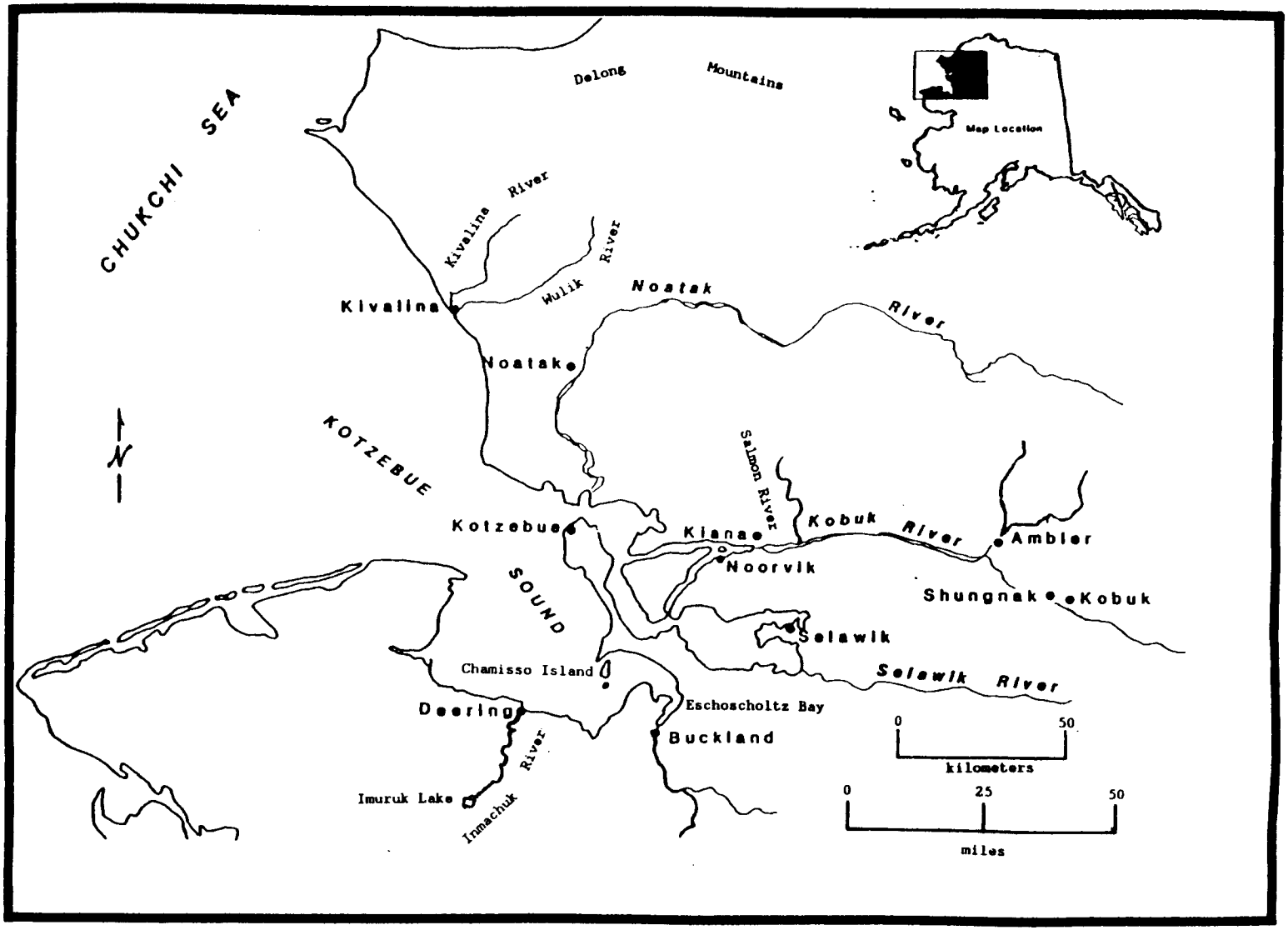

Figure 14. Kotzebue Sound and surrounding area.

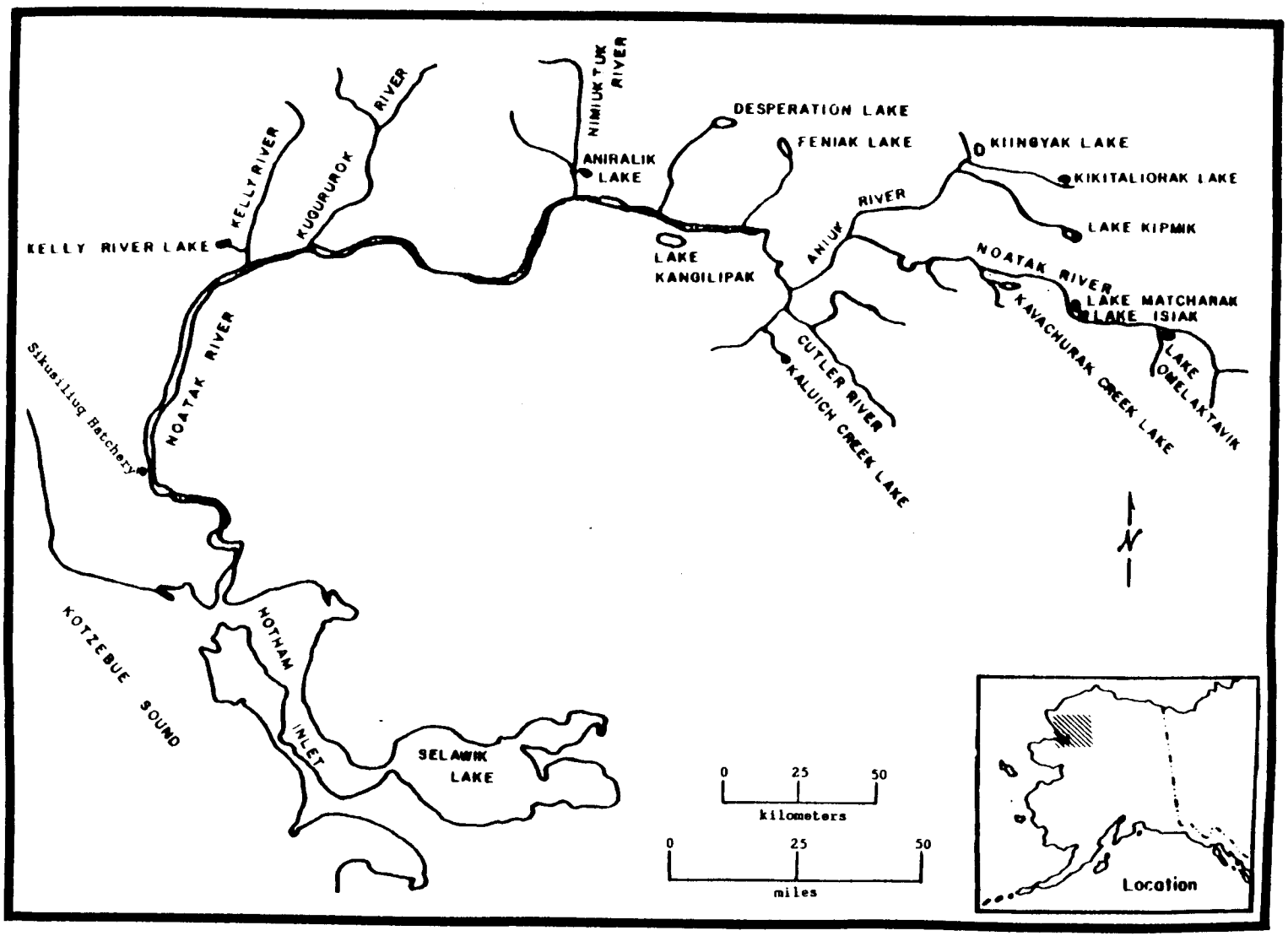

Figure 15. Waters of the Noatak River.

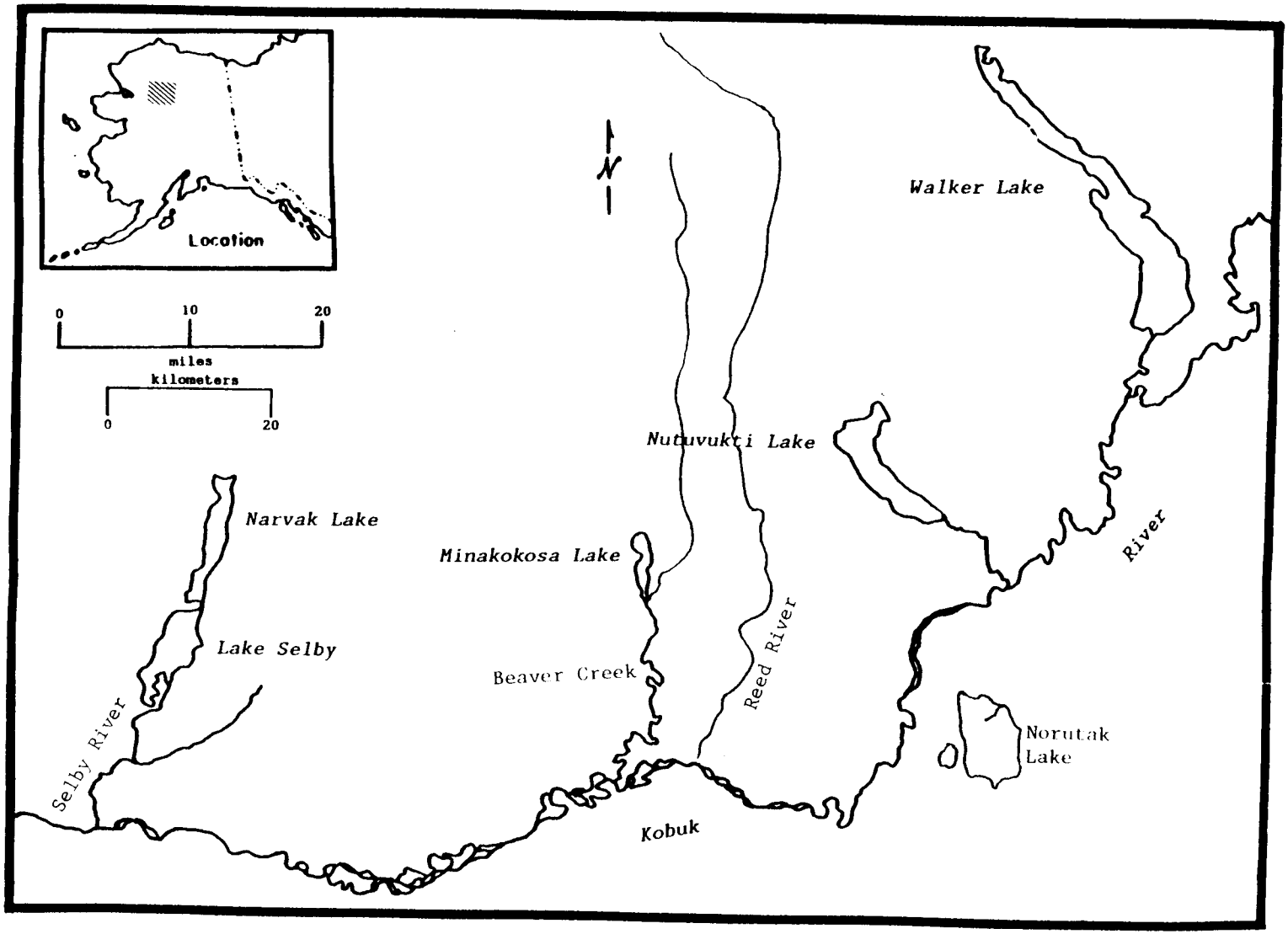

Figure 16. Waters of the upper Kobuk River.

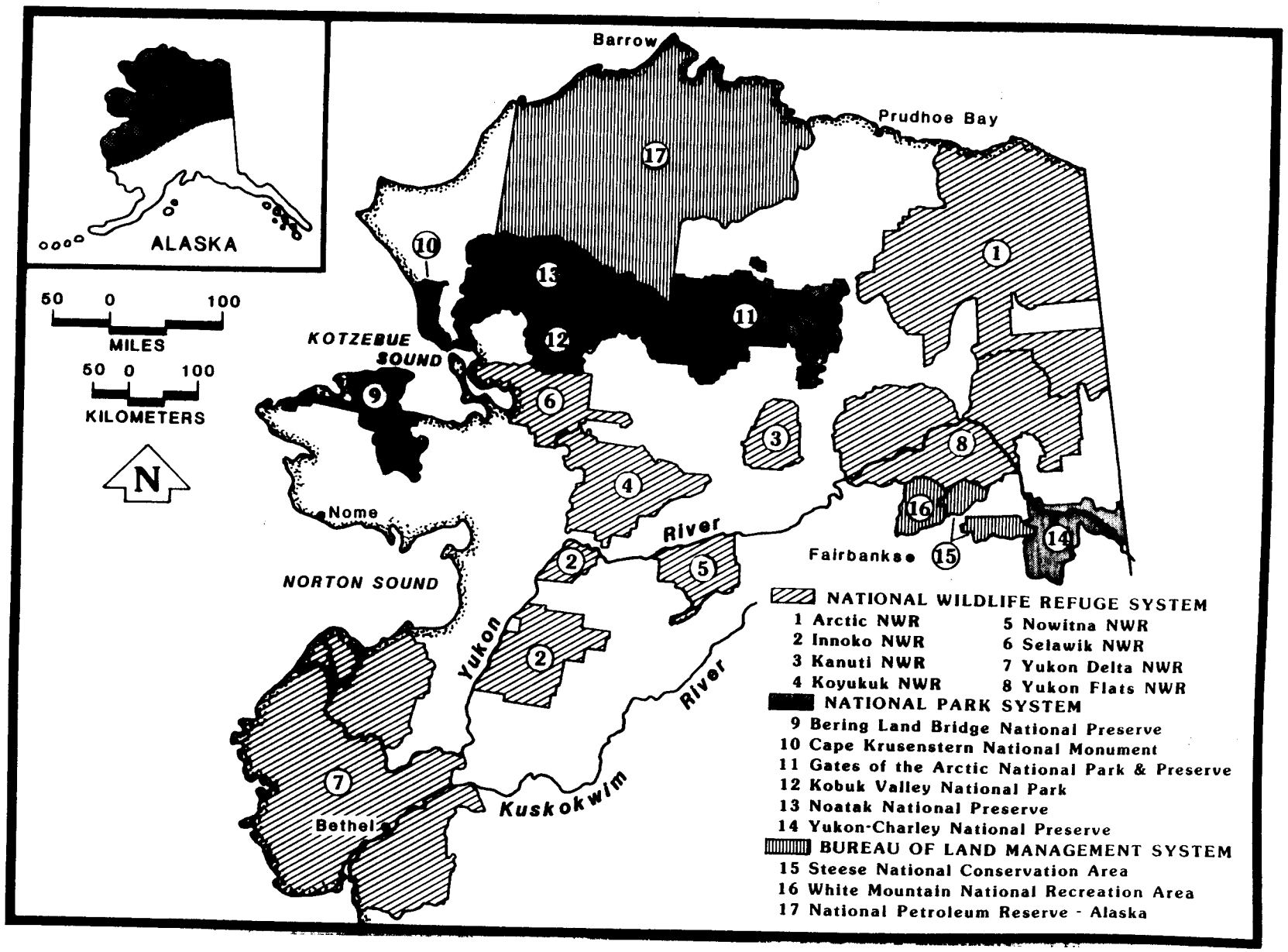

Figure 17. Federal land designations within the A-Y-K region.

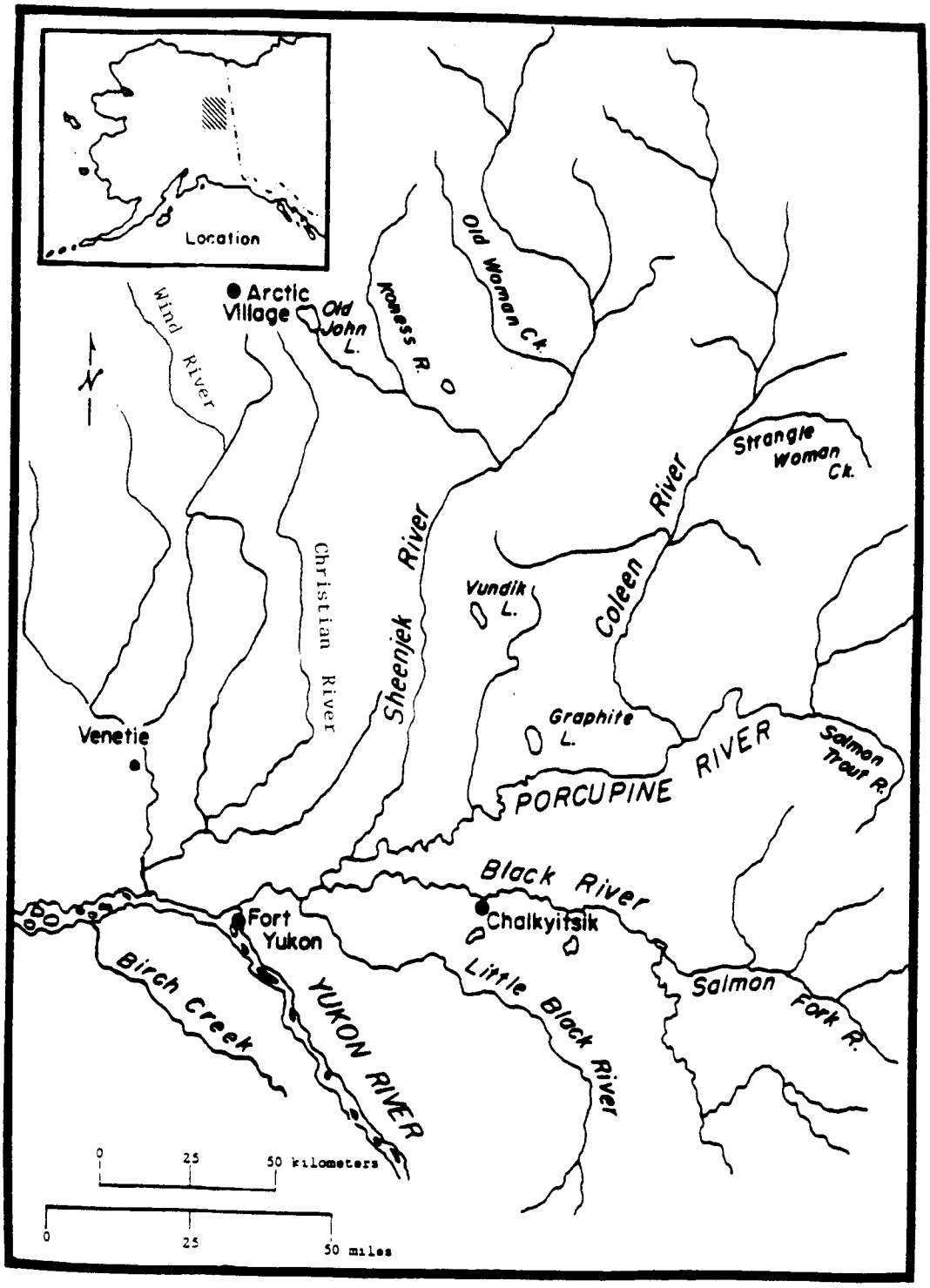

Figure 18. Porcupine River drainage.

fishing with hook and line for sheefish takes place near Kotzebue in the summer.

Guided and unguided anglers and river floaters use the Noatak River as do Kotzebue area residents who boat to different parts of the river to fish. The most popular fishing area is the Kelly River, but other tributaries such as the Nimiuktuk and Kugururok rivers are also used occasionally primarily for Dolly Varden fishing (Alt 1978, 1981a).

Raft, canoe, and kayak trips are increasingly popular recreational uses on the Noatak River. Many parties put in at Matcharak Lake (Figure 18) and portage to the river, or land wheel aircraft on gravel bars farther upstream. Arctic grayling, Dolly Varden and lake trout are available in the upper Noatak River, but downstream from the Nimiuktuk River, chum salmon and northern pike also occur. Lake trout occur in Matcharak, Feniak, and Desperation lakes and in other lakes in the middle and upper Noatak drainage. Most lakes in the area are accessible only by floatplane.

The lower floodplains of the Kobuk and Selawik rivers, especially in the vicinity of the Kobuk River delta, and the lower Noatak River (upstream of the lower canyon of the Noatak) contain hundreds of shallow thaw lakes of various sizes. Fisheries resources of the waters in this area are poorly inventoried, but large populations of whitefishes, northern pike, and sheefish are known to be seasonally present. The mountains in the upper Kobuk River drainage (Figure 12) contain several relatively large, deep lakes which were formed by glacial action. Lake trout, Arctic grayling, Arctic char and perhaps one or two whitefish species inhabit these lakes. They include Walker Lake, Nutuvukti Lake, Minakokosa Lake, Lake Selby and Narvak Lake.

Lakes of the upper Noatak River (Figure 18) were surveyed by Alt (1978), with a brief inventory of 13 lakes in the upper drainage. Fish were present in all lakes surveyed, and round whitefish *Prosopium cylindraceum*, lake trout and Arctic grayling were the most common species. Least cisco, northern pike, Dolly Varden, slimy sculpin *Cottus cognatus*, salmon (chum and sockeye), and ninespine stickleback *Pungitius pungitius* were also found.

South Slope Brooks Range:

The south slope of the Brooks Range sub-area (statewide harvest Area Y; Figure 1) includes all drainages south of the Brooks Range, west of and including the Koyukuk and Alatna River drainages, and north of the Yukon River, including all northern tributaries of the Yukon River from Kaltag to the Canadian border.

A major portion of the south slope Brooks Range sub-area is contained within the boundaries of the Gates of the Arctic National Park and Preserve. Most of the streams in the area drain to the south from the Brooks Range into the Yukon, Koyukuk, and Porcupine rivers (Figures 15, 16, and 17). Significant flowing waters include the Alatna River, and other Koyukuk River tributaries such as the Gisasa, Kateel, Dulbi, Huslia, Indian, Kanuti, Hogatza, Dakli, Henshaw, John, Wild, North Fork, Tinayguk, South Fork, Middle Fork, and Jim rivers. To the east are the Dall, Hodzana and Hadweenzic rivers, the

Chandalar River with several tributaries and forks, the Christian River, and the lower Porcupine River with tributaries such as the Sheenjek, Coleen, Black, and Little Black rivers. The Dalton Highway (North Slope Haul Road) bisects the sub-area in a north-south direction (Figure 17), and provides access for recreational fishermen to several streams of the area, including the Ray River, the Middle Fork and South Fork of the Koyukuk River, as well as Prospect Creek and Jim River of the upper Koyukuk River system.

The Nulato River enters the Yukon River near Nulato, about 775 km from the mouth of the Yukon River. Smaller and more difficult to navigate than the Anvik River, the stream nevertheless has sport fishing potential for salmon, Arctic grayling, Dolly Varden and northern pike. The stream receives some seasonal sport fishing use at the present time from anglers stationed at a U.S. Air Force station in Galena.

The mouth of the Melozitna River supports fisheries for sheefish and Arctic grayling during summer and early fall. Geothermal hot springs occur on one of the creeks of the Melozitna River, and a permanent lodge there caters to hunters and fishermen. The Melozitna River is also utilized frequently by local fishermen for Arctic grayling, particularly in the lower 16 km below rapids which effectively isolate the upper reaches of this stream.

The Koyukuk River, one of the largest first order tributaries of the Yukon, enters the Yukon River downstream from Galena, about 820 km from the mouth (Figure 19). The main stem of the Koyukuk is turbid in its lower reaches from tannic stain, bank erosion and leaching. Lower Koyukuk River tributaries such as the Gisasa, Kateel, Dulbi, and Indian rivers are not well known outside of the local area but seasonally provide good sport fishing opportunities. Sheefish are taken at the mouths of several streams including the Kateel and Dulbi rivers and where John Junior Slough meets the Koyukuk River about 32 km upstream from the mouth. Arctic grayling are common in clear tributary streams and local residents of nearby villages as well as military personnel stationed at the Galena Air Station fish for them. Sport fishing for northern pike takes place commonly in sloughs and lakes near the main stems of the Yukon and Koyukuk rivers as well as in the extensive Kaiyuh Flats southeast of Galena. Since sheefish spawn in the main stem of the Koyukuk River near Hughes, there are both immature and adult mature prespawning individuals present in the lower Koyukuk River throughout the summer prior to the September spawning period (Alt 1987).

Other Yukon River tributaries below the Porcupine River confluence (Figures 7 and 19) that support sport fishing include the Tozitna River, Ray River, Dall River, Hodzana River, Hadweenzic River, Chandalar River, and Christian River. Upper Koyukuk River tributaries that cross the Dalton Highway (North Slope Haul Road) are illustrated in Figure 17.

The Yukon flats is an extensive wilderness wetland between Circle and Stevens Village below the confluence of the Porcupine River. Portions of the Yukon flats that are located north of the Yukon River are included with the South Slope Brooks Range sub-area. Thousands of shallow thaw lakes have developed throughout the flats. Many of the lakes support fish populations, at least seasonally, especially those with occasional connections to the sloughs and

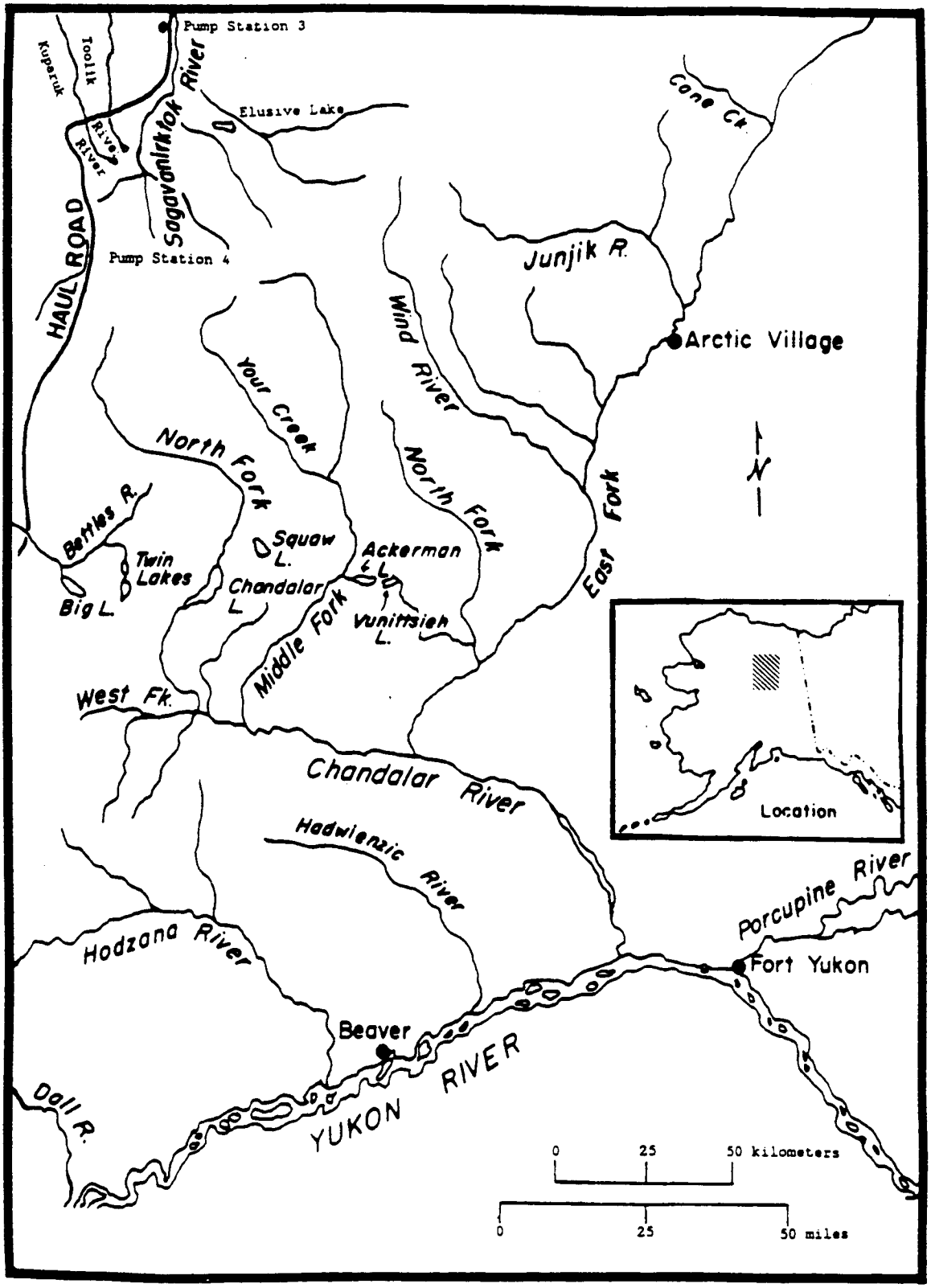

Figure 19. Chandalar River system.

streams in the area. Northern pike and whitefish species are most common to this area, but sheefish and Arctic grayling also occur in some waterways (USFWS 1985). Salmon production is very limited in the Yukon flats proper. The area between Beaver Village and Fort Yukon on the Yukon River main stem is known to support sheefish spawning (Alt 1987a). This sub-area contains approximately half of the Yukon Flats National Wildlife Refuge, (Figure 14) and there are literally thousands of lakes present of various sizes and origins. The lakes of the area are categorized roughly (USFWS 1985) into: (1) foothill lakes (formed from streams, with sufficient depth for fish habitation); (2) tundra lakes (which are shallow and often freeze to the bottom); and (3) lowland lakes of three types: oxbow lakes with river connections and deep enough to support fish, mud lakes (shallow, and suitable for only fish rearing), and lakes created from beaver activity. There is currently little documentation available on resident fishes that utilize these vast wetlands. The U.S. Fish and Wildlife Service is conducting inventories and lake surveys in the waters of the Yukon Flats Refuge to provide information on this subject.

The Porcupine River (Figure 15) is the largest Yukon River tributary, draining an immense area of the eastern Brooks Range through the Sheenjek and Coleen rivers, the British Mountains through the Old Crow River, the Richardson Mountains in Canada through the Bell, Eagle, and Rock rivers, and the northern Ogilvie Mountains in north-central Yukon Territories through the east Porcupine Fork and its tributaries. The Black River which drains the southeastern slopes of the Ogilvie Mountains is one of it's major Alaskan tributaries. The Little Black River drains a lowland area south of the Black River parallel to the main stem of the Yukon River.

Other major tributaries between Fort Yukon and the Canadian border are all above Circle City, and include the Charley, Seventymile, and Fortymile rivers on the south side of the Yukon River (Tanana Area) and the Nation, Kandik, and Tatonduk rivers entering the north side (South Slope Brooks Range sub-area) of the Yukon River (Figure 8). Parts of Birch and Beaver creeks as well as parts of the Charley and Fortymile rivers are designated as National Wild and Scenic Rivers (Appendix A). The major species for sport fishing on the rivers upstream of Fort Yukon are Arctic grayling in the upper stream reaches and northern pike in the lower slower sections.

Several large mountain lakes are present. They include Iniakuk, Wild, Big, Twin, Chandalar, Ackerman, and Old John lakes (Figures 15, 16 and 17). All are believed to contain lake trout populations as well as Arctic grayling and other species of whitefish and cisco in most cases.

North Slope Brooks Range:

The north slope of the Brooks Range sub-area (statewide harvest Area Z; Figure 1) includes all waters north of the Brooks Range divide flowing into the Beaufort and Chukchi Seas from Point Hope on the west to the Canadian border on the east including adjacent saltwater areas.

The northern-most part of Alaska is characterized by its broad Arctic coastal plain, which abuts the Arctic Ocean and Beaufort Sea, and by the foothills and

mountains which form the Brooks Range (Figure 20). The central and eastern Brooks Range consist of rugged, glaciered, east-trending ridges with summits rising to elevations of 4,350 to 5,000 m. The Delong Mountains on the western flank of the Brooks Range consist of glaciered ridges, 1,865 to 2,500 m in elevation, which drain northward into the Chukchi Sea. Only a few small lakes and no glaciers exist in the Delong Mountains although they were glaciered during the ice age. From the central and eastern Brooks Range, the mountain rivers flow northward to the Beaufort Sea. As Selkregg (1976) points out, although several large rock basin lakes lie at the mouths of glaciered valleys on both sides of the range, there are surprisingly few lakes for a glaciered area. Although most of the streams that cross the foothills flow northward from their sources in the range, the region's largest stream, the Colville River flows eastward for more than 320 km before turning north onto the coastal plain (Figures 20 and 21). The drainage area of the Colville River is about 62,000 km^2, a little more than half of the area drained by the Tanana River. Most streams east of the Colville River are braided and cross broad gravel flats that are often blocked in winter by aufeis (fields of ice that form continuously downstream from spring water sources) that cause local flooding (Selkregg 1976). The upper valleys of major rivers flowing from the Brooks Range often contain morainal lakes.

The coastal plain is an area of low relief and poor drainage due to underlying permafrost and a shallow active layer, factors that lead to moisture entrapment near the surface. Rivers that cross the plain originate in the hills or mountains to the south. In the west, more than half of the plain is covered by oriented thaw lakes aligned to the north-northwest on their long axes. Ice-wedge polygons are found throughout the coastal plain section.

Major flowing waters of the coastal plain from west to east, include the Kukpowruk, Utukok, Kuk, Meade, and Itpikpuk rivers (Figure 20). The Colville River has several major tributaries, including the Killik, Chandler, Anaktuvuk, and Itkillik rivers (Figure 21). Streams east of the Colville River include the Kuparuk, Sagavanirktok (Figure 22), Canning, Hulahula, and Kongakut rivers (Figure 20).

The North Slope is accessible by air travel or by driving the Dalton Highway north from Fairbanks. The highway was originally built in 1974 to support construction of the Trans-Alaska oil pipeline. Sport fishing was closed for 8 km (5 miles) on either side of the pipeline beginning in 1978 to prevent rapid fisheries depletion by construction workers along the Trans-Alaska Pipeline. The closure was rescinded in 1980 by the Alaska Board of Fisheries when the Haul Road Corridor was opened for fishing for all species except sheefish and salmon (Bendock 1980). Since June 1981, the highway south of Disaster Creek (near Dietrich, Figure 17) has been open to travel by the general public (Bendock 1982). The Alaska Board of Fisheries opened the Haul Road Corridor for sheefish fishing in 1987, but salmon fishing remains closed.

The Dalton Highway crosses tributaries of the Sagavanirktok, Toolik, and Kuparuk rivers and parallels the Sagavanirktok River for about 160 km (100 miles) south of Prudhoe Bay, providing access to sportfishing opportunities for Arctic grayling, lake trout, Dolly Varden and Arctic char (Figure 17). There are numerous small lakes between Ribdon River (tributary to the

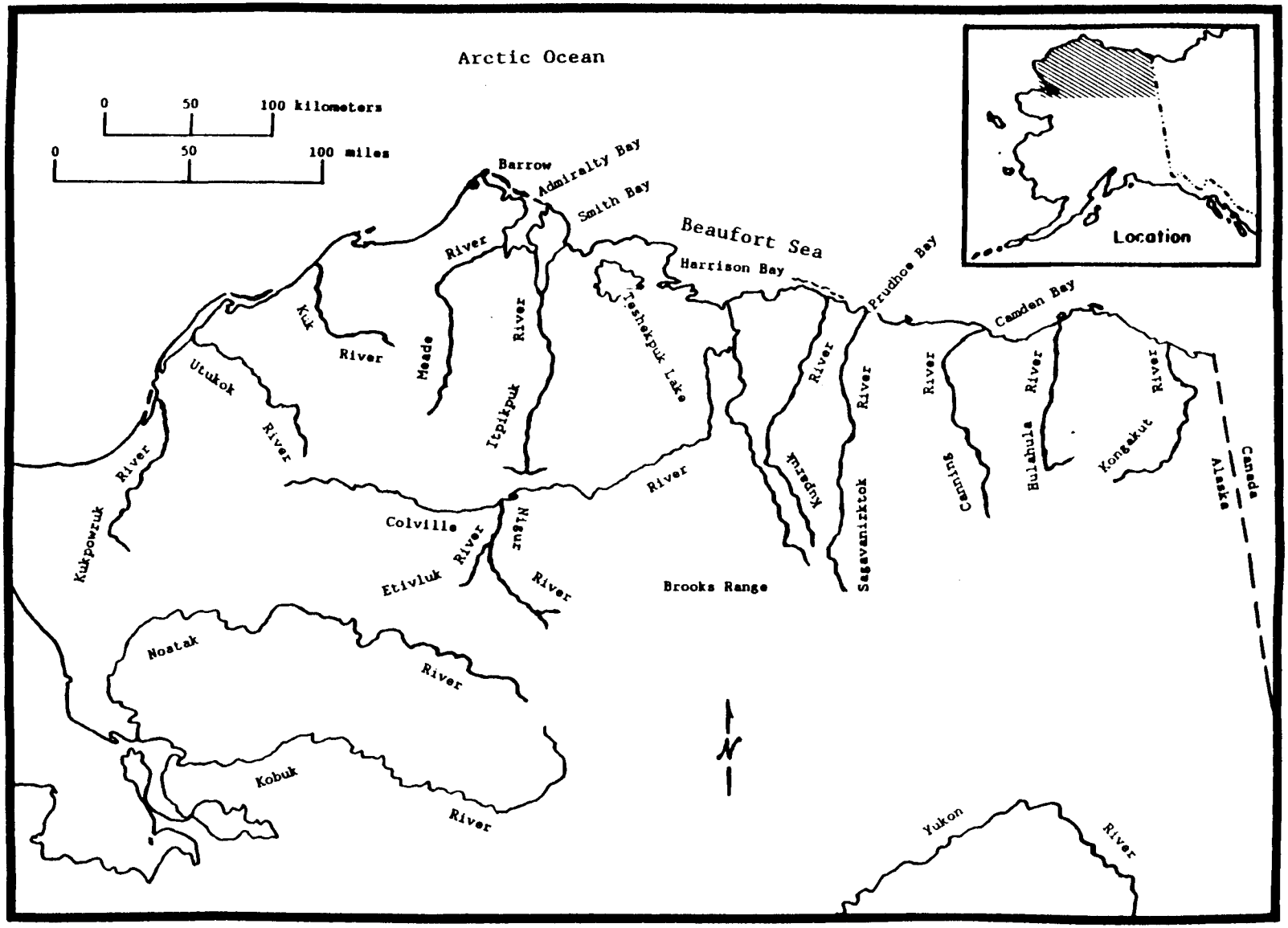

Figure 20. Waters of the Arctic Slope.

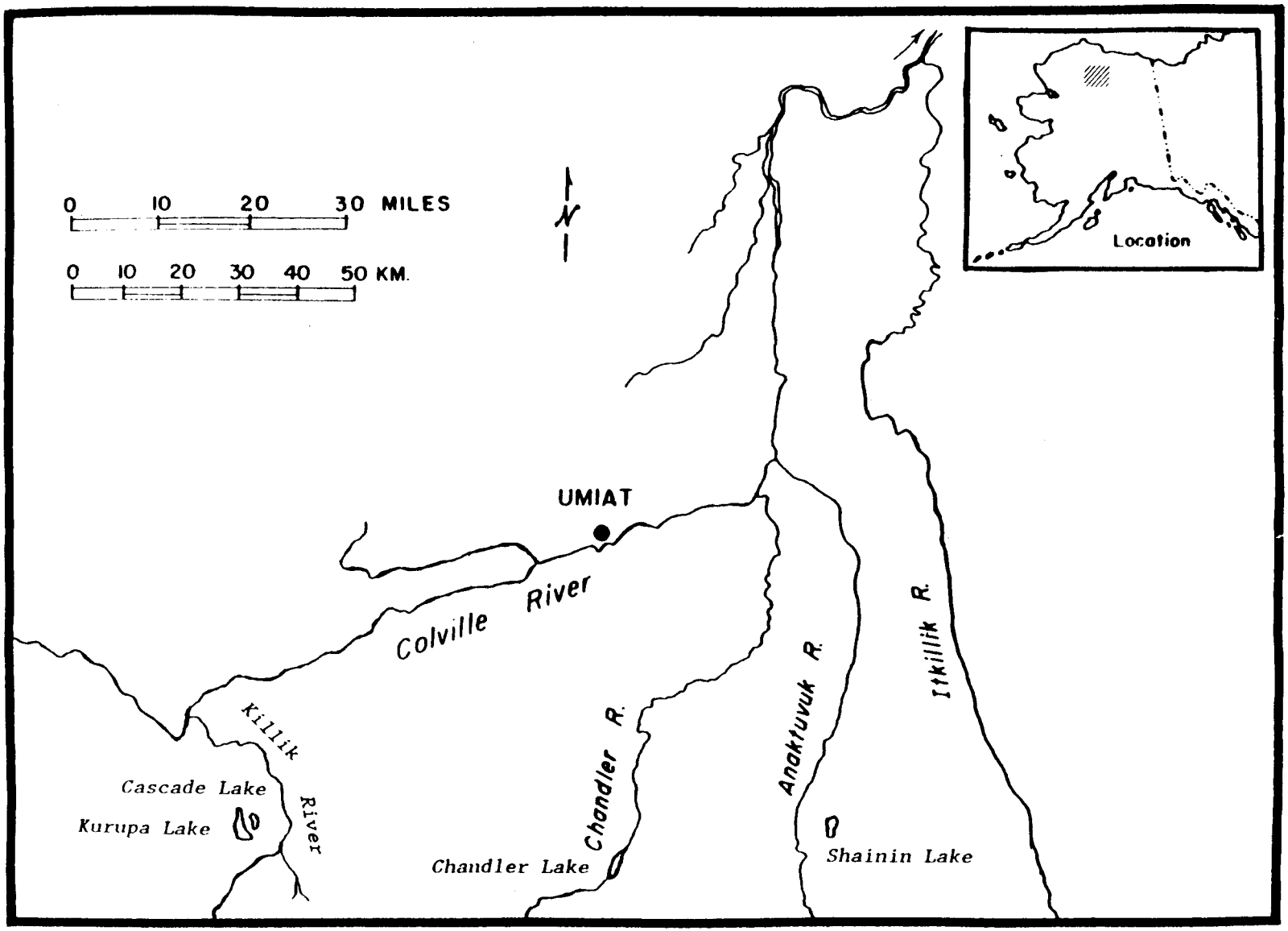

Figure 21. Principal tributaries of the Colville River.

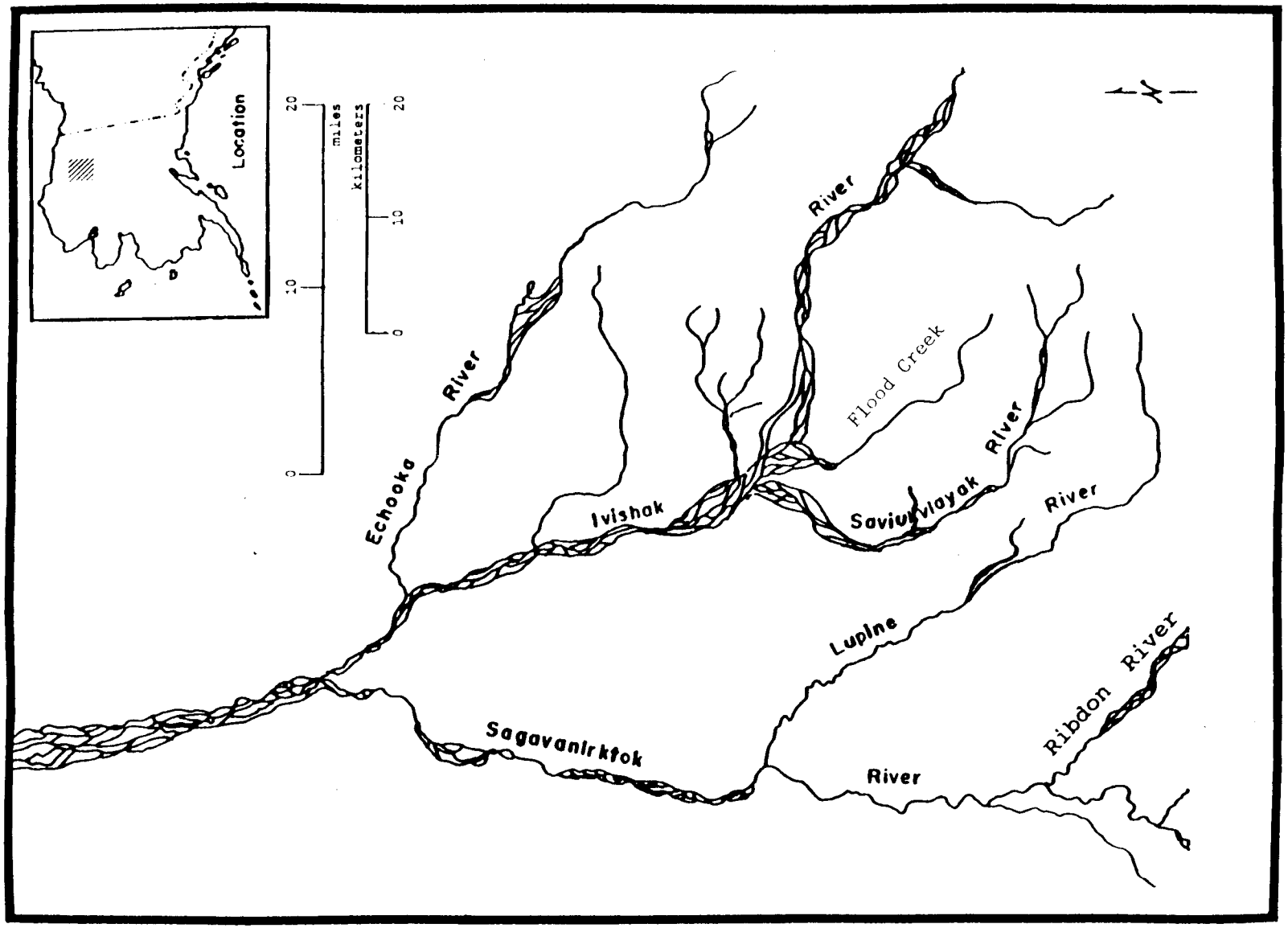

Figure 22. Principal tributaries of the Sagavanirktok River.

Sagavanirktok River) and Galbraith Lake that provide good fishing opportunities for these species (Figure 22).

Light sportfishing effort also takes place on the Colville, Kongakut, Canning, Ivishak, Echooka, Killik, and Anaktuvuk rivers, as well as the Hula Hula River (ADFG 1986). Some fishing may also be done by parties floating the Nigu and Etivluk rivers (Bendock 1983). A significant proportion of the sportfishing in this sub-area is by persons engaged in hunting activities as their main pursuit.

Lakes such as Toolik Lake in the upper Kuparuk River and Galbraith Lake in the upper Sagavanirktok River are two of the most frequently fished lakes north of Atigun Pass (Bendock and Burr 1984). Other popular lakes along the Haul Road include Island, Campsite, and Tea lakes. Lakes outside the Dalton Highway Corridor that receive sportfishing effort include Elusive, Shainin, Itkillik, Cascade, Kurupa, and Chandler lakes (Figures 19 and 21; Furniss 1974; NPS 1985a).

AYK Area Climate

Because of geographic and topographic diversity and size, annual climatic parameters vary considerably throughout the area. Except for the immediate coastal areas, a continental type of climate prevails over much of the AYK Area, with warm summers, cold winters and little precipitation. Annual precipitation is usually sparse except for the areas under coastal influence. In lower latitudes, the amount of precipitation generally received in the AYK Area would result in arid conditions similar to those found in many deserts of the world. Because of cooler temperatures in Alaska, and the fact that a great deal of moisture is trapped in permafrost soils, desertification has not occurred, and, in fact, much of the area gives the appearance of having received abundant moisture. Typical summer weather lasts from mid-June until late August or early September, with rainy weather typical during August and September. Snowfall is usually light even in the coastal areas of the AYK Area, as compared to other areas of the state.

Species of Importance to the Sport Fishery

In addition to the species listed for the Tanana Area, Dolly Varden and Arctic char are important to sport fishing in many waters of the AYK Area. Wild stocks of rainbow trout occur as far upstream in the Kuskokwim River drainage as the Aniak River and its tributaries. Rainbow trout do not occur naturally north of the Kuskokwim River, although they have been stocked in two lakes of the AYK Area. Pink salmon are an important sport fish species in the Norton Sound and Seward Peninsula sub-area where there is sport fishing effort in both freshwater and marine waters. Additional species of whitefish that are of importance to fisheries in the AYK Area include the broad whitefish, *Coregonus nasus*, Arctic cisco, *Coregonus autumnalis*, and Bering cisco, *Coregonus laurettae*. All other species listed under the Tanana Area are also found in the AYK Area.

Status and Harvest Trends of Wild Stocks

A brief description of the AYK Area sport fisheries follows.

Chinook Salmon:

Chinook salmon spawn throughout the Kuskokwim and Yukon River drainages and in streams of eastern Norton Sound and the southern Seward Peninsula. Chinook salmon occur in streams north of the Seward Peninsula, but no stocks identified are sufficiently abundant to support commercial or sport fisheries. Concentrated sport fishing occurs in only a few streams in the AYK Area, and the majority of the sport harvest is taken by local residents. More intensive sport fishing occurs in Norton Sound on the Unalakleet River and on the Seward Peninsula in parts of the Fish River system where commercial guiding and lodging facilities have been developed to promote sport fishing for salmon. Guided fishing for chinook salmon also takes place on the Holitna River in the Kuskokwim drainage. The Salmon River (Kuskokwim River tributary) near Nikolai and McGrath also supports a sport fishery on a chinook salmon spawning stock by local residents who use hook and line gear (Stokes 1985). An undocumented amount of angling for chinook salmon takes place on both the Andreafsky and Anvik rivers. Few chinook salmon are harvested in the AYK and Tanana Areas compared to other management areas in Alaska (Mills 1987). Since 1980 the AYK Area chinook salmon sport harvest has ranged from about 1,000 to 2,600 fish, with the majority taken from streams in the lower Yukon-Kuskokwim sub-area (Mills 1988)[2]. The SWHS indicates only a slight increase in harvest since 1980, from levels of about 1,900 in 1980 to harvest estimates of about 3,000 chinook salmon in 1988 (Table 2). A total of 1,292 large sea-run chinook salmon were harvested in 1988 in the AYK Area. In addition, 1,673 small sea-run chinook salmon (less than 711 mm in length) were harvested in the AYK Area (Mills 1989). When totalled, the estimated harvest of both small and large chinook salmon is 2,965 fish.

Coho Salmon:

Coho salmon are distributed widely south of the Brooks Range in the AYK Area, however, they are more abundant in the Kuskokwim River drainage and in drainages to the south than in drainages north of the Kuskokwim River. Returns of coho salmon to the Kuskokwim River may be the largest to a single river in Alaska. Approximately 660,000 coho salmon were harvested in the 1986 Kuskokwim River commercial fishery, historically the largest commercial harvest for this system (Francisco et al. 1987). Western Alaska coho salmon are thought to spawn primarily in spring-fed portions of streams. The upper Kuskokwim River and its tributaries that drain the northern slopes of the Alaska Range, are extensively underlain with alluvial gravels as a result of outwash from the Alaska Range. The resulting gravel aquifers provide high quality, spring water for spawning and rearing of coho salmon in the Kuskokwim drainage and fall chum salmon in the Yukon and Tanana River drainages. SWHS results in 1988 indicate that the majority of the coho salmon recreational harvest in the AYK Region was from streams of the Seward Peninsula and Norton

[2] Reported harvest figures include fish taken from lower Kuskokwim River and Kuskokwim Bay streams.

Sound and from the Kuskokwim River and Yukon River exclusive of the Tanana River area (Mills 1989). The sport harvest estimate of coho salmon from the lower Yukon-Kuskokwim sub-area in 1988 was 4,675 fish, of which 1,837 were taken from the Kanektok River (Table 3).

Coho salmon are locally abundant north of the Yukon River in Norton Sound, where coastal and stream fisheries occur at least as far north as Teller. Several streams of eastern Norton Sound (Figures 11 and 12) including the Unalakleet, and Shaktoolik, Fish, and Niukluk rivers support spawning stocks of coho salmon, as do many of the streams in the Nome area, Port Clarence, and Safety Sound. Active sports fisheries occur in these areas for coho salmon. The 1988 SWHS harvest estimate for coho salmon in Norton Sound and the Seward Peninsula is 5,038 fish (Table 4). Coho salmon occur north of Port Clarence, but as with other rearing salmon species, their abundance decreases markedly at higher latitudes.

Pink Salmon:

This species rarely undertakes extensive freshwater migrations (more than 160 km) and as a consequence, it is not abundant upstream of the lower main stems of the major river systems of the AYK Region. For example, pink salmon seldom ascend the Yukon River beyond the Anvik River (513 km), or the Kuskokwim River beyond the Holitna River (540 km). Significant sport harvests of pink salmon were reported only for the Norton Sound-Seward Peninsula sub-area (2,912 fish) and for the lower Yukon-Kuskokwim sub-area (892 fish) in 1988 (Tables 3 and 4).

Pink salmon are a target species in Norton Sound sport fisheries where harvest estimates have ranged from 1,100 (1985) to more than 13,000 (1982). The recent (1979-1988) ten year average sport harvest is 4,892 fish. Pink salmon utilize numerous streams in Norton Sound for spawning, and in some years large returns are documented. Extremely large returns have been recorded for the Unalakleet River, the Kwiniuk River and Tubutulik River (Lean et al. 1986). For example more than 6 million pink salmon are estimated to have spawned in the Unalakleet River in 1984 (Lean 1985). Returns of this species are extremely variable even in more southerly latitudes. The common two-year cycle of pink salmon return abundance is not as pronounced in Norton Sound and in more northerly areas, although the magnitude of return variation is large because of climatic variation at higher latitudes. Snow cover, depth, and mean monthly temperatures during the winter months all affect ice thickness and the amount of frozen versus unfrozen groundwater in local streams of the area. Salmon egg and fry survival rates are directly affected by the amount of freezing in the stream gravels where incubation takes place.

Non-rearing species such as pink and chum salmon may have an advantage in northern streams where freshwater productivity is much lower than in lower latitudes. Sport and subsistence fisheries in the Nome area for pink salmon in local streams such as the Nome, Snake and Sinuk rivers are active in late July and early August.

Table 3. Interior Alaska[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	KI[c]	KS	SS	LL	RS	PS	CS	LT	DV AC	RT	GR	WF	SF	NP	BB	SM
SALTWATER:																			
Boat	62	62	62	36	0	36	0	0	0	0	0	0	0	0	0	0	0	0	0
Shoreline	62	433	509	0	0	91	0	0	0	0	0	0	0	0	0	0	0	0	0
SALTWATER TOTAL	124[d]	495	571	36	0	127	0	0	0	0	0	0	0	0	0	0	0	0	0
FRESHWATER:																			
Kanektok River	1,145	1,609	12,697	1,073	837	1,837	0	109	437	618	0	2,146	400	164	18	0	18	0	248
Other Streams	3,159	4,828	12,257	346	182	2,711	0	637	455	764	72	2,164	1,199	3,186	910	1,074	3,546	91	0
Lakes	310	310	646	0	0	0	0	0	0	0	109	0	0	0	0	0	455	0	0
FRESHWATER TOTAL	3,960[d]	6,747	25,600	1,419	1,019	4,548	0	746	892	1,382	181	4,310	1,599	3,350	928	1,074	4,019	91	248
GRAND TOTAL	4,022[d]	7,242	26,171	1,455	1,019	4,675	0	746	892	1,382	181	4,310	1,599	3,350	928	1,074	4,019	91	248

[a] Interior Alaska (Area V): All southern drainages of the Yukon River from its confluence with the Tanana River to Kaltag; all drainages of the Yukon River south of Kaltag, including the Kuskokwim River and all waters flowing into Kuskokwim Bay; does not include the Tanana River and the Koyukuk River drainages.

[b] KS: chinook salmon; SS: coho salmon; LL: landlocked coho or chinook salmon; RS: sockeye salmon; PS: pink salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; RT: rainbow trout; GR: Arctic grayling; WF:various whitefish; SF: sheefish; NP: northern pike; BB: burbot; SM: smelt;

[c] Chinook salmon less than 711 mm (28 in)

[d] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 4. Seward Peninsula-Norton Sound Area[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	KI[d]	KS	SS	RS	PS	CS	DV AC	GR	WF	NP	BB	SM	OTHER
SALTWATER:																
Boat	248	217	272	0	0	36	0	0	0	291	55	18	0	0	0	62
Shoreline	310	433	550	0	0	164	0	55	0	127	0	0	0	0	62	309
SALTWATER TOTAL	557[e]	650	822	0	0	200	0	55	0	418	55	18	0	0	62	371
FRESHWATER:																
Nome River	1,578	5,384	5,639	0	0	1,291	0	528	273	2,001	891	0	0	0	1,547	0
Pilgrim River	743	1,330	4,729	0	55	218	746	36	346	327	109	36	91	0	0	0
Fish-Niukluk River System	804	1,330	2,183	0	0	800	0	73	127	891	1,237	0	0	0	0	0
Other Streams	1,889	5,353	6,812	218	127	2,529	36	2,220	837	1,218	2,636	619	473	36	619	0
Lakes	93	31	93	0	0	0	0	0	0	0	0	0	0	0	0	0
FRESHWATER TOTAL	2,661[e]	13,428	19,456	218	182	4,838	782	2,857	1,583	4,437	4,873	655	564	36	2,166	0
GRAND TOTAL	3,001[e]	14,078	20,278	218	182	5,038	782	2,912	1,583	4,855	4,928	673	564	36	2,228	371

[a] Seward Peninsula-Norton Sound (Area W): All drainage area north of the Yukon River drainage, including all saltwater north and west of Pastol Bay in Norton Sound; and, south of the Selawik River drainage. Does not include the Selawik River.

[b] KS: chinook salmon; SS: coho salmon; RS: sockeye salmon; PS: pink salmon; CS: chum salmon; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: various whitefish; NP: northern pike; SM: smelt;

[c] From Mills 1989

[d] Chinook salmon less than 711 mm (28 in)

[e] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Arctic Grayling:

Arctic grayling inhabit waters throughout the AYK Area where they are probably the most popular sport fish species present. Most of the freshwater drainages that have been surveyed along the Arctic coast contain Arctic grayling (USFWS 1982). It is the principal species inhabiting foothill lakes and streams on the Seward Peninsula and they occur in lakes and streams emptying into the Chukchi Sea between Kotzebue and Barrow (ADFG 1978, 1986). Arctic grayling also migrate through, or inhabit during parts of the year, main stems and tributaries of the largest rivers such as the Yukon, Kuskokwim, Porcupine, Koyukuk, Kuskokwim, Noatak, Kobuk and Colville rivers.

Arctic grayling typically spawn in smaller, clear headwaters with gravel bottoms and low stream gradients, usually during May and early June. After spawning, the adults disperse throughout the streams for summer feeding. Juveniles and sub-adults are frequently found rearing during summer months in far upstream reaches that become dewatered in winter. Fish overwinter in lower stretches of tributaries where water and oxygen concentrations are adequate, as well as in lakes and spring fed portions of streams. Summary descriptions of distribution, life history and abundance of Arctic grayling in the AYK Region are provided in Alaska Habitat Management Guides for the Interior, Western and Arctic Regions (ADFG 1986).

SWHS results indicate that since 1977, the Arctic grayling harvest in the AYK Area has ranged from about 10,000 fish in 1977 to more than 30,000 in 1983. Since 1983, estimated harvests have declined, and have ranged from 15,500 in 1984 to 19,700 in 1986, with 16,302 being taken in 1988 (Table 2). The Arctic grayling harvest is usually taken fairly evenly from the five sub-areas, with from 2,000 to 9,000 Arctic grayling taken in each sub-area (Tables 3 - 7). The largest harvest in 1988 (4,928 fish) occurred in the Seward Peninsula/Norton Sound sub-area (Table 4).

Northern Pike:

Sloughs, interconnected lakes, and the lower sections of large rivers throughout most of the AYK Area are inhabited by northern pike. Lowland areas of the Yukon and Kuskokwim rivers are particularly noted for large northern pike. Northern pike are abundant in all parts of the AYK Area containing appropriate habitat except on the north slope of the Brooks Range, where their distribution is limited. Bendock and Burr (1985) reported the presence of northern pike on the Arctic coastal plain west of the Colville River, in rivers and lakes draining into Admiralty and Smith Bays (Figure 20) and in middle reaches of the Killik River, tributary to the Colville River.

During summer, northern pike are generally distributed near shore in shallow water that contains aquatic vegetation and a mud bottom. Northern pike have some tolerance for salinity and they are taken frequently in brackish waters of the Yukon-Kuskokwim Delta. They are not known to feed or travel extensively in marine or coastal waters outside the major rivers. During winter, northern pike congregate in deep, well-oxygenated waters found in the

Table 5. Northwest Alaska Area[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	KS	CS	LT	DV AC	GR	WF	SF	NP
SALTWATER:											
Shoreline	31	31	31	0	0	0	0	0	0	0	0
SALTWATER TOTAL	31[d]	31	31	0	0	0	0	0	0	0	0
FRESHWATER:											
Other Streams	1,207	3,187	4,702	18	236	91	965	2,674	182	964	1,492
Lakes	341	495	546	0	0	164	18	18	54	0	73
FRESHWATER TOTAL	959[d]	3,682	5,248	18	236	255	983	2,692	236	964	1,565
GRAND TOTAL	990[d]	3,713	5,279	18	236	255	983	2,692	236	964	1,565

[a] Northwest Alaska (Area X): Kotzebue area including drainages of Selawik, Kobuk, Noatak, Wulik, and Kivalina Rivers. All saltwater in the northern half of Kotzebue Sound to and including Point Hope.

[b] KS: Chinook salmon; CS: chum salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: various whitefish; SF: sheefish; NP: northern pike.

[c] From Mills 1989

[d] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 6. South Slope Brooks Range Area[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	KS	DV AC	GR	SF	NP	BB
Haul Road Streams	960	2,321	1,898	0	0	928	0	91	0
Other Streams	1,550	1,921	2,745	73	54	3,421	201	1,599	18
Other Lakes	93	93	93	0	18	0	0	0	0
TOTAL	2,011[d]	4,335	4,736	73	72	4,349	201	1,690	18

[a] South Slope Brooks Range (Area Y): All drainages south of the Brooks Range and north of the Yukon River; including all northern drainages of the Yukon River from Kaltag to the Canadian Border, and, all drainages of the Koyukuk River and Alatna Rivers.

[b] KS: Chinook salmon; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; SF: sheefish; NP: northern pike; BB: burbot.

[c] From Mills 1989

[d] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

Table 7. North Slope Brooks Range Area[a] sport fish harvest and effort by fisheries and species[b], 1988[c].

	Anglers	Trips	Days Fished	PS	LT	DV AC	GR	WF
SALTWATER:								
Boat	62	62	62	0	0	0	0	0
Shoreline	186	743	486	55	0	0	0	18
SALTWATER TOTAL	217[d]	805	548	55	0	0	0	18
FRESHWATER:								
Haul Road Streams	526	1,578	992	0	0	327	437	0
Other Streams	434	465	807	0	0	655	400	0
Haul Road Lakes	155	217	158	0	73	0	91	0
Other Lakes	31	31	36	0	0	36	55	0
FRESHWATER TOTAL	897[d]	2,291	1,993	0	73	1,018	983	0
GRAND TOTAL	1,052[d]	3,096	2,541	55	73	1,018	983	18

[a] North Slope Brooks Range (Area Z): All Alaskan waters, including drainages, north of the Brooks Range and flowing into the Beaufort and Chukchi Seas to the north and east of Point Hope. Does not include Point Hope.

[b] PS: pink salmon; LT: lake trout; DV/AC: Dolly Varden or Arctic char; GR: Arctic grayling; WF: various whitefish.

[c] From Mills 1989.

[d] Angler totals may not equal sum of sites due to some anglers fishing at more than one site.

lower reaches of tributaries or other areas of sufficient water flow (Hallberg 1984).

Most of the recreational harvest of northern pike is taken with hook and line. Spearing, bow and arrow, and hand jigging techniques are also legal means and account for a small proportion of the total harvest. Fishing for northern pike takes place in the Kuskokwim River drainage from McGrath to downstream of Bethel, including the Takotna, Nixon Fork, Holitna, and Johnson rivers. Most recreational fishing for northern pike along the Yukon River takes place upstream from Galena. Popular areas include the Yukon Flats near Fort Yukon, Koyukuk River, Beaver Creek, Birch Creek, Dall River, Hess Creek, Tozitna River, Melozitna River, and Nowitna River. The Pilgrim, Kuzitrin, Fish, and Niukluk rivers in the Nome area are popular as well.

Major use of northern pike in the AYK area is probably for subsistence. Although harvest levels are largely undocumented, they are thought to exceed recreational harvests. Much of the recreational and some of the subsistence harvest is taken during winter months through the ice with hook and line gear. Sport fishing for northern pike has gained in popularity since the early 1960's. Northern pike are eagerly sought by fishermen in areas that have good boat access. They are often fished in the fall in combination with hunting activities.

The estimated sport harvest of northern pike in the AYK Area has ranged from about 2,000 fish in 1977 to more than 8,600 fish in 1983 (Mills 1979-1989). The estimated harvest in 1988 was 7,838 fish (Table 2). Generally, the largest harvests have been taken in the lower Yukon-Kuskokwim River sub-area. Estimated 1988 harvest from this sub-area was 4,019 northern pike, followed by 1,690 from the south slope Brooks Range sub-area. (Tables 3 - 7).

Little is known concerning the status of northern pike stocks in the AYK Area, but because of remoteness and restricted access, fishing effort is light except on those stocks near towns and villages where angling and subsistence gill netting effort may be more intense. Northern pike populations close to the Yukon River Haul Road Bridge have experienced more angling pressure because the recent opening of the road has allowed easy boat access to people living in the Fairbanks area. Northern pike population studies conducted in the Tanana River drainage suggest that abundance and stock composition parameters such as age and size composition respond negatively and rapidly when annual harvest exploitation rates exceed 16%.

Lake Trout:

Historically, approximately 35% of the total AYK Region harvest of lake trout has occurred in the AYK Area. In 1986, the percentage taken outside the Tanana River drainage was much larger (88%) due to declines in catch and perhaps abundance within the Tanana River drainage. Harvest in 1988 for the entire region totalled 2,730 fish, of which 509 fish (19%) were taken from the AYK Area (Table 2). Harvest values for the AYK Area since 1977 have ranged from about 500 fish in 1977 and 1988 to about 2,500 in 1986 (Table 2).

ADFG studies indicate that lake trout resources have been overharvested in many of the more accessible waters of south-central and interior Alaska. Specific life history features (slow growth, delayed maturity, and non-consecutive spawning) combined with the shortened growing season at higher latitudes and altitudes increases the vulnerability of the species to overharvest.

Burr (1987a) described the distribution of lake trout in Alaska. Lake trout are most frequently associated with deep, oligotrophic lakes in the mountains and are rarely found at lower elevations of the Yukon or Kuskokwim basins (Redick 1967; Morrow 1980). In northwest Alaska, lake trout occur in lakes and streams of the Brooks Range in the Noatak and Kobuk River drainages. Lake trout are found in most drainages that flow into the Yukon River from the Brooks Range. Lake trout distribution is primarily restricted to lakes at higher elevations in these drainages. Lake trout are widely distributed on the north slope of the Brooks Range. They occur most frequently in mountain and foothill lakes, but they also occur in streams of the Colville, Sagavanirktok, and Canning River drainages. Lake trout generally do not occur in the lowland lakes of the Arctic coastal plain, but they occur commonly in central coastal plain lakes between the Ikpikpuk and Colville rivers.

ADFG has conducted little research on this species in areas outside of the Tanana Valley and near Glennallen. Lake trout research is being conducted by federal agencies, such as USFWS, NPS (National Park Service), and BLM (Bureau of Land Management) in National Wildlife Refuges, National Parks, National Preserves and other unclassified lands.

Dolly Varden/Arctic Char:

The majority of the harvest of Arctic char or Dolly Varden (collectively referred to as char in this section) in the region occurs in the AYK Area since only the dwarf stream resident form is found in the upper Yukon and Tanana River systems. Char occur in most of the waters of western and Arctic Alaska, either in the anadromous, river resident, lake resident, or stream dwarf forms. Char are a target species for subsistence and sport fisheries in waters of the Arctic, Kotzebue vicinity, Seward Peninsula, and Norton Sound.

Two species are recognized within the AYK Area based upon meristic characters, (gill raker and pyloric caecae counts), life history features and the occurrence of anadromy (Behnke 1980). Dolly Varden are the dominant species from Bristol Bay north to the Arctic plain, and occur in either the anadromous, stream resident or stream dwarf form, while Arctic char occur only as residents in foothill lakes of the North Slope (Chandler Lake Campsite Lakes, etc; Figure 21), the Kobuk River drainage (Walker and Selby lakes; Figure 16), the Seward Peninsula (lakes of the Kigluaik Mountains; Figure 23), and the Kuskokwim Mountains (Aniak, Kisaralik, Kagati, and Goodnews lakes; Figure 9). The majority of char in the AYK Area are Dolly Varden of either the stream resident or anadromous type. They occur throughout the area but are most abundant in tributaries of the lower Yukon and Kuskokwim rivers, Norton Sound, Northwest Alaska, and along the north slope of the Brooks Range and the Arctic coastal plain. Morrow (1980) distinguishes two distinct forms of Alaska Dolly Varden (*Salvelinus malma*) based upon gill raker and vertebral

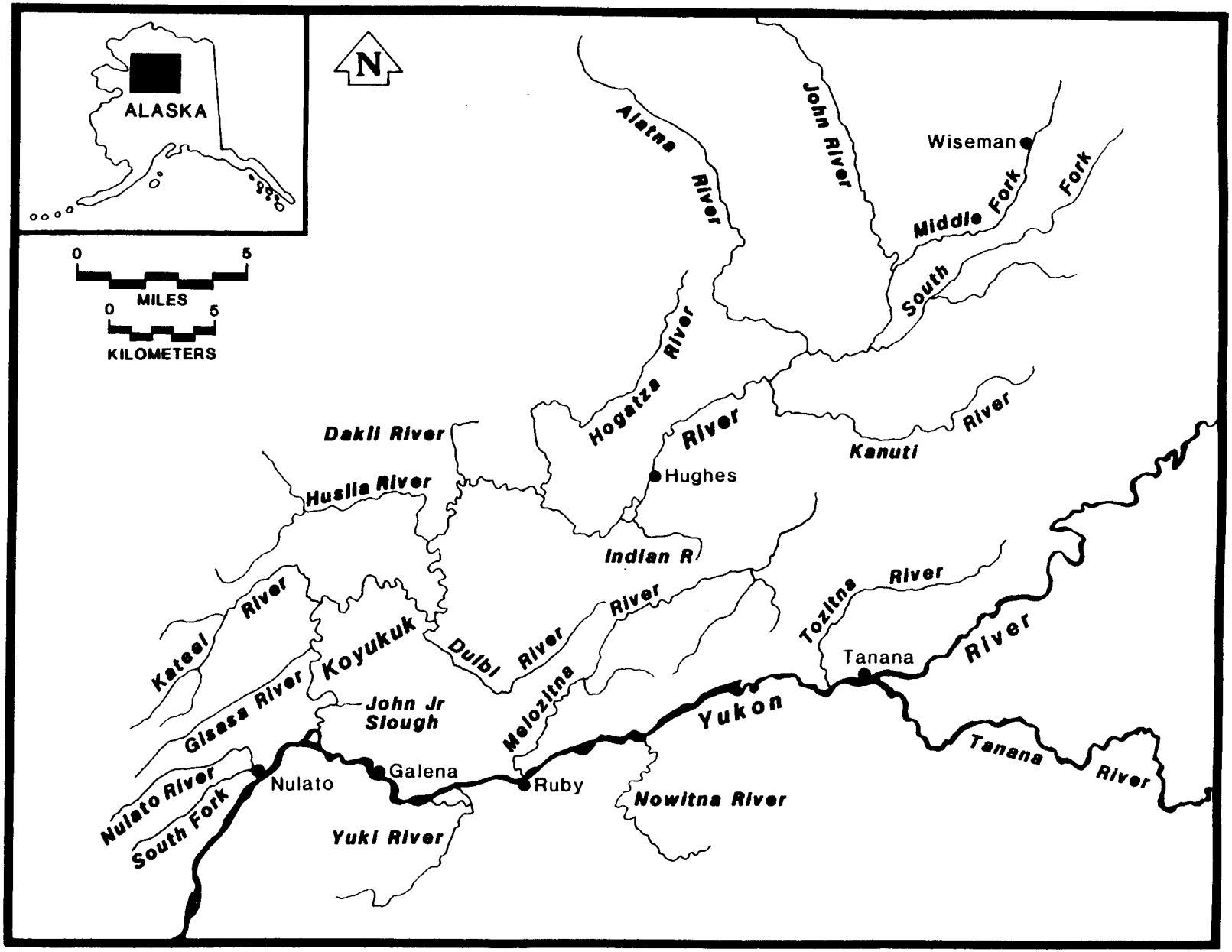

Figure 23. Middle Yukon River and Koyukuk River drainages.

counts. Generally the southern form occurs only south of the Alaska Range, however examination of specimens collected in the upper reaches of the Copper, Tanana, Nenana, and Susitna Rivers indicates the presence of southern and northern forms on both sides of the passes in the stream resident or stream dwarf forms. Morrow (1980) argues that headwater transfer, which may still be occurring, is responsible for the mixing of the southern and northern forms in these areas.

Sport harvests of char in the AYK Area between 1977 and 1988 have ranged from approximately 4,000 fish to more than 20,000 fish. This represents from less than 5% to about 20% of the statewide total harvest (Mills 1979-1989). The estimated harvest in 1988 was 11,238 fish from the AYK Area, with similar harvests from three of the sub-areas (lower Kuskokwim-Yukon, Seward Peninsula/Norton Sound and South slope of the Brooks Range). Typically, the largest percentage of the harvest is taken in the Norton Sound and Seward Peninsula sub-area. High quality sport fishing for char is available in northwest Alaska, particularly in the Wulik, Kivalina, and Noatak rivers north of Kotzebue, when trophy Dolly Varden move into the streams for either overwintering or spawning in the fall. The Noatak River in northwest Alaska supports populations of spawning char in its tributaries. Important spawning tributaries include the Kelly River, Kogururok River, and the Nimiuktuk River. Incidental commercial harvest as well as directed subsistence harvests account for the highest proportion of the annual fishing mortality in northwest Alaska in most years (Bernard and DeCicco 1987).

Many trophy char have been registered from the AYK Area. During the period from 1967 to 1987, 16 trophy char (20% of the Alaska total) were recorded, including the state record of 7.9 kg (17 lbs 8 oz) taken from the Wulik River in 1968. All except one of the trophy char taken in the AYK Area came from northwest Alaska.

Burbot:

Burbot are distributed throughout the AYK Area in all major rivers and many of the lakes and minor waterways. It is an important fisheries resource for the subsistence economy in rural Alaska and for sport fisheries. Burbot are members of the cod family, *Gadidae*, and spawn in midwinter under the ice of rivers and lakes. Sport fishing interest and intensity has increased for the species in recent years, particularly near settlements where burbot fishing provides an outdoor wintertime activity for many people. Reported annual sport harvests of burbot in the AYK Area since 1978 have ranged from just over 100 fish to approximately 2,000 fish (Table 2). The majority of the harvest and fishing effort occurs in the winter with lines set through the ice, although hand-held lines with rod and reel are also used in summer and winter months. The majority of the burbot sport harvest in the AYK Region takes place in the Tanana River drainage. Less than 200 fish of the total 3,878 burbot taken in 1988 were from areas outside the Tanana River drainage (Table 2).

Only three of the 154 Alaska trophy burbot registered from 1967 to 1988 were taken in the AYK Area, a fact that is no doubt reflective of lack of sport fishing effort in much of the area.

Whitefish:

Although members of the whitefish family, *Coregonidae*, are seldom considered to have substantial recreational value, as a group they constitute an extremely important fisheries resource in the AYK Area. They are taken year around by subsistence fisheries and are utilized for human consumption as well as for dog food. In addition, various whitefish species provide a forage base for many of the predatory fishes that support important sport fisheries such as northern pike, burbot, and sheefish. The most important whitefish species in northern, western and interior Alaska include the humpback whitefish, broad whitefish, round whitefish *Prosopium cylindraceum*, Arctic cisco, least cisco, and Bering cisco.

Recreational fisheries throughout the area account for a very small proportion of the total harvest of all species of whitefish. An estimated harvest of 1,855 whitefish was taken by sport anglers in 1988 in the AYK Area. The magnitude of the whitefish subsistence harvest is not well documented except in a few specific instances, but is believed to be orders of magnitude greater than the sport harvest in the AYK Area. Where salmon are not available, and during the winter months, whitefish are the major source of fish for subsistence use. Such a situation prevails over the entire North Slope, and in many of the remote villages of interior Alaska located beyond the upstream limits of the salmon runs. Limited commercial fisheries for whitefish exist in the AYK Area.

Sheefish:

Sheefish are large, predatory whitefish found throughout western, interior, and northwestern Alaska. They do not occur in streams of the North Slope nor in Norton Sound north of the Koyuk River. Alt (1987) identified nine stocks of sheefish, with anadromous-estuarine stocks occurring in the Kuskokwim, lower Yukon, Koyuk, Kobuk-Selawik rivers, and resident non-anadromous stocks in Yukon River tributaries of the Nowitna, Tanana River (Minto Flats), Porcupine, and Salmon Fork of the Black River, as well as the main stem of the upper Yukon River. The distribution of this species in Alaska is limited to the AYK Region.

Sheefish are harvested by subsistence, commercial, and recreational users with subsistence harvests exceeding all others. The major commercial fishery (Kotzebue Sound) is limited by a harvest quota of 11,350 kg or approximately 3,300 fish annually (Lean 1985). Reported sales of sheefish from this commercial fishery have only once (in 1977-78) reached the allowed quota (Lean et al. 1986). During the period from 1978-1988, the recreational harvest in the AYK Area ranged from about 1,000 to about 3,600 fish (Table 2). Kobuk and Selawik River sheefish are the most abundant and heavily fished stocks. Harvest occurs on a year-round basis from subsistence, commercial and sport fishermen, from spawning grounds in the upper Kobuk River to the coastal inlets, Hotham Inlet and Selawik Lake near Kotzebue and Selawik villages. The data base for sheefish stocks of the Kobuk and Selawik rivers is not adequate to allow the precise determination of sustainable yields for the stocks. The size of the spawning stocks has been poorly documented as has the harvest and

biological composition of the harvest. Because of life history features that favor late maturation, slow growth, nonconsecutive spawning, and the existing harvest pressure on major stocks, there is concern that the Kobuk and Selawik river stocks may be experiencing harvests beyond sustainable levels. The question cannot be addressed until further biological information becomes available.

Sheefish generally overwinter in lower reaches of rivers and estuarine waters, migrate upstream in summer to feeding grounds, and migrate further upstream to spawning grounds in the late summer and fall. Migrations of over 1,650 km have been documented. Sheefish spawn in late September and early October at water temperatures of 0 - 5°C. Aerial survey estimates of the number of spawning sheefish on the Kobuk and Selawik rivers are available for seven years between 1966 and 1979. The highest aerial survey count for the Kobuk River was 8,166 spawning sheefish in 1971 (Alt 1987). A total of 1,243 spawners was observed in the Selawik River in 1968, one of two years when surveys were made on this stream. It is not certain that spawning grounds have been identified for all major sheefish stocks. Availability of spawning habitat with desired current (2 m per sec), water depth (2 m), and bottom substrate of differentially-sized gravels may be the most critical factor limiting sheefish distribution and abundance (Alt 1987).

Rainbow trout:

In only two known instances have rainbow trout been introduced into waters of the AYK Area. Approximately 3,000 fingerling were released into a man-made, landlocked reservoir known as Webster Reservoir in Prudhoe Bay in 1977. Fate of the transplanted fish was not assessed in subsequent years. Since the reservoir is used as an industrial water source in the winter, water levels are often drawn down severely, increasing the likelihood of winter kill from hypoxia or freeze-out.

In a second instance, rainbow trout were released into Roy's Pond near Central in 1987. The pond is a 15.38 ha (38 ac) waterbody with an outlet stream that does not flow except at extreme high water, into Crooked Creek, tributary to Birch Creek in the Yukon River drainage. The 1987 release consisted of 10,000 fingerling rainbow trout. The success of the stocking in producing catchable rainbow trout in the pond in subsequent years has not been assessed.

STAFF ORGANIZATION

Regional Staff Responsibilities

Organization of the region staff is outlined in Figure 24. All activities were under the overall direction of the Regional Supervisor (J. Clark) who delegated appropriate tasks to the Administrative Assistant (E. Nielsen), the Research Supervisor (R. Holmes) and the following Fishery Biologist III's: W. Arvey, J. Hallberg, and M. Kramer. Lake stocking activities were the responsibility of M. Doxey. Area management responsibility and emergency order authority was vested with two positions, W. Arvey (AYK Area), and J.

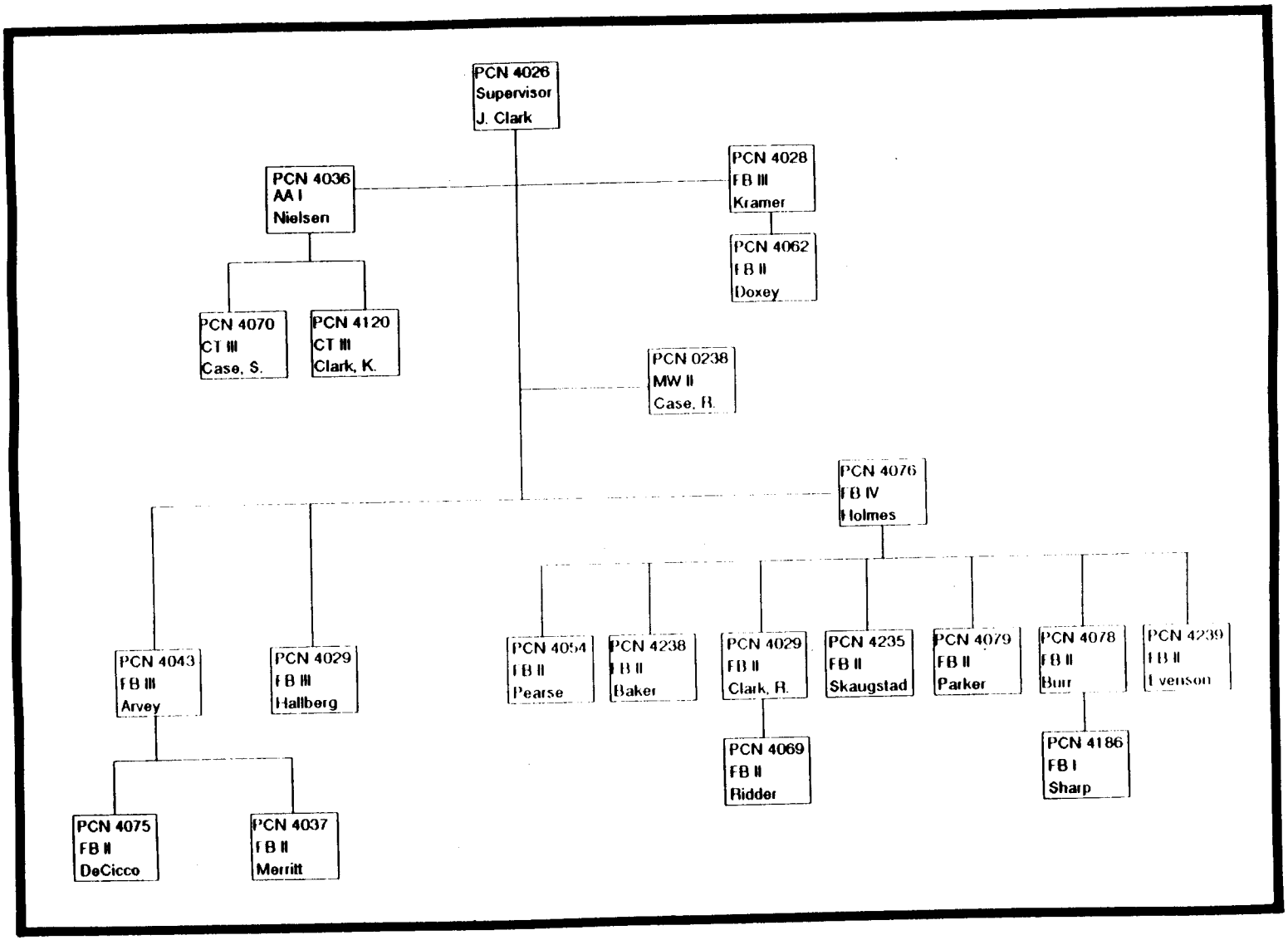

Figure 24. Organizational chart for A-Y-K Sport Fish staff, 1988.

Hallberg (Tanana Area). Each area manager conducted fisheries research projects in the respective areas. The AYK Area biologist was responsible for northern pike, Arctic grayling and Dolly Varden projects, the Tanana River Area biologist for a whitefish project. Special research was conducted by W. Ridder on Arctic grayling in Mineral Lake outlet, Shaw Creek, Richardson Clearwater River, and Goodpaster River, all in the upper Tanana Valley. Arctic grayling research in the Salcha, Chena, and Chatanika rivers near Fairbanks, and in Fielding Lake near Delta was conducted by R. Clark. T. Baker conducted Arctic grayling research in the Tangle Lakes and was also responsible the interior Alaska creel census project. M. Merritt conducted a study of Arctic grayling on the Seward Peninsula. Char research was conducted in northwest Alaska by A. DeCicco. Lake trout research in the Tanana River drainage and Copper River was conducted by J. Burr and D. Sharp. Burbot research in rivers of the upper Tanana Valley was conducted by M. Evenson. F. Parker conducted a study of burbot in lakes of interior Alaska. Northern pike studies were conducted by G. Pearse in the Tanana River drainage, and by W. Arvey in the Dall River. Evaluation of the fish stocking program was conducted by C. Skaugstad, M. Doxey, and J. Clark. Research on whitefish was conducted by J. Clark and D. Bernard. Adult chinook salmon abundance in the Salcha River was estimated by C. Skaugstad. Fisheries information and education were the duties of M. Kramer.

Synopsis of Published Reports

The intent of the following section is to provide a brief overview of AYK Region fisheries studies completed during the reporting year. Since AYK Region activities are documented by technical reports following each field season, the report itself is cited, followed by a brief synopsis.

Arvey, W.D. and A.F. DeCicco 1989. Northern pike in the vicinity of the Yukon River Haul Road crossing, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 105. 33 pp.

Northern pike were tagged and sampled from six streams located in the vicinity of the Yukon Haul Road Bridge to estimate abundance of the population of northern pike living in the Dall River and to determine whether that population is closed or open to immigration. A recapture event was scheduled for 1989 to complete the population estimate, however recaptures in 1988 indicated that immigration to, and emigration from, the Dall River occurs, and that the population must be considered geographically open . Size-at-age data showed that growth rates of northern pike residing in the Dall River are the highest of any population studied to date in interior Alaska.

Baker, T.T. 1989a. Creel censuses conducted in interior Alaska in 1988. Alaska Department of Fish and Game. Fishery Data Series No. 95. 110 pp.

Creel censuses were conducted on seven of the major fisheries within the Tanana River drainage in 1988. These fisheries included Chatanika River whitefish spear fishery, upper Chena River Arctic grayling fishery, lower Chena River chinook salmon fishery, Delta Clearwater River Arctic grayling fishery, Piledriver Slough rainbow trout and Arctic grayling fisheries, Salcha

River chinook and chum salmon fisheries, and Tangle lakes and River system Arctic grayling fishery. In addition, fishermen targeting Dolly Varden char at Prudhoe Bay and for Arctic grayling on the Seward Peninsula were interviewed. Various statistics including angler effort, catch-per-unit-effort (CPUE), harvest-per-unit-effort (HPUE), catch, and harvest were estimated for these fisheries.

Baker, T.T. 1989b. Stock assessment of Arctic grayling in the Tangle Lakes and River system, 1986-1988. Alaska Department of Fish and Game. Fishery Data Series No. 92. 54 pp.

In 1988, a comprehensive study was undertaken to assess the mixing rates of Arctic grayling among their major spawning, summer-rearing, and over-wintering areas in the Tangle lakes and River system. This study was intended to assess the status of Arctic grayling throughout the system. Tagging data are presented from sampling trips conducted during 1986, 1987, and 1988. From 1986 to 1988, 9,537 Arctic grayling were captured in the Tangle System, with 5,226 marked with tags.

Burkholder, A. 1989. Movements, stock composition, and abundance of northern pike in Minto Flats during 1987 and 1988. Alaska Department of Fish and Game. Fishery Data Series No. 116. 29 pp.

Evidence is presented for two geographically distinct sub-populations in Minto Flats. Overwintering areas were identified with telemetric methods. Estimated abundance of northern pike in the study area greater than 299 mm in fork length was 23,293 fish in 1987 and 26,116 fish in 1988. Combined sport and subsistence harvest exceeded what is thought to be the maximum sustainable yield in 1987.

Burr, J.M. 1989. Stock assessment and biological characteristics of lake trout populations in interior Alaska, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 99. 57 pp.

Population abundance of lake trout was estimated with mark-recapture experiments in three lakes located in the Tanana River drainage. The estimated abundance of lake trout greater than 250 mm was 647 in Sevenmile Lake and 211 in Upper Tangle Lake. The estimated abundance of lake trout greater than 240 mm in Twobit Lake was 1,621. Biological data from lake trout captured in Paxson, Butte, and Fielding lakes are presented.

Clark, J.H. and D.R. Bernard 1989. Fecundity of humpback whitefish and least cisco, Chatanika River, Alaska. Alaska Department of Fish and Game. Fishery Data Series No. 77. 28 pp.

The relationship between fork length and fecundity for two coregonid species was developed. Predicted fecundity for humpback whitefish ranged from 6,905 eggs per female for fish 305 mm in length, to 80,203 eggs per female for fish with fork length of 545 mm. Predicted fecundity for least cisco ranged from 32,138 eggs per female for fish 285 mm in length, to 80,494 eggs per female for fish 445 mm in fork length.

Clark, J.H. and M. Doxey 1988. Abundance and length composition of sockeye salmon and least cisco in pelagic waters of Harding Lake, Alaska, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 76. 20 pp.

Tow net sampling and area-swept methods indicated an estimated abundance of 25,495 sockeye salmon and 33,301 least cisco in the upper 9.14 m of the Harding Lake water column. Density of stocked sockeye salmon was in the low range of densities reported for natural stocks in Alaskan lakes, but growth rate was slightly higher than reported for natural stocks. Survival rate of stocked sockeye salmon was estimated to be 5% over the course of their first four months in the lake.

Clark, R.A. 1989a. Stock status of Chena River Arctic grayling. Alaska Department of Fish and Game. Fishery Data Series No. 97. 49 pp.

Estimated population abundance in the lower 72 km of the Chena River was 7,760 Arctic grayling with fork length greater than 149 mm. Abundance of Arctic grayling was estimated at 14,444 fish greater than 149 mm in fork length in the upper 80 km of the Chena River. Annual recruitment between 1986 and 1987 was 2,526 fish, and annual survival during this period was 43.9 %. Recruitment increased to 3,373 fish between 1987 and 1988, with an increase in survival to 57.1 %.

Clark, R.A. 1989b. Stock assessment of Arctic grayling in the Salcha and Chatanika Rivers. Alaska Department of Fish and Game. Fishery Data Series No. 74. 36 pp.

Population abundance in a 16 km section of the Salcha River was 2,181 Arctic grayling greater than 149 mm fork length. Growth characteristics indicate that Salcha River Arctic grayling grow faster, on average, than Chatanika River fish after age 3.

Clark, R.A. 1989c. Stock assessment of Arctic grayling in Fielding Lake. Alaska Department of Fish and Game. Fishery Data Series No. 78. 26 pp.

Mark-recapture estimates of population size (fish greater than 199 mm fork length) were 6,578 in June 1986 and 3,924 in June 1987. Estimated annual survival rate of marked fish between 1986 and 1987 was 49.0 %, while recruitment over the same time was 788 fish.

Doxey, M. 1989. Evaluation of stocked waters in the Tanana drainage, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 106. 49 pp.

A combined total of 2,567,469 rainbow trout, Arctic grayling, coho salmon, chinook salmon, sockeye salmon, sheefish, and Arctic char were stocked in 58 lakes and ponds in interior Alaska. Survival rates for fish stocked in a few ponds is estimated. Initial assessments indicate that Arctic char can survive in Harding Lake. Rainbow trout stocked in Piledriver Slough survived the winters of 1987-88 and 1988-89.

Evenson, M.J. 1989. Biological characteristics of burbot in rivers of interior Alaska during 1988. Alaska Department of Fish and Game. Fishery Data Series No. 109. 47 pp.

Six sections of the Tanana River, one section of the Tolovana River, and one section of the Chena River were sampled. Movements, relative population density, (CPUE), age, and size-at-age of burbot captured is reported.

Hallberg, J.E. 1989. Abundance and size composition of Chatanika River least cisco and humpback whitefish with estimates of exploitation by recreational anglers. Alaska Department of Fish and Game. Fishery Data Series No. 108 22 pp.

Estimated abundance of humpback whitefish in 1988 was 41,211. Estimated rate of exploitation of humpback whitefish was 0.09, lower than in 1986 and 1987.

Merritt, M.F. 1989. Age and length studies and harvest surveys of Arctic grayling on the Seward Peninsula, 1988. Alaska Department of Fish and Game. Fishery Data Series No.79. 32 pp.

Arctic grayling were sampled from streams on the Seward Peninsula to estimate length, age, length-at-age, and growth.

Parker, J.F., Lafferty R., Potterville W.D. and D.R. Bernard 1989. Stock assessment and biological characteristics of burbot in lakes of interior Alaska during 1988. Alaska Department of Fish and Game. Fishery Data Series No. 98. 86 pp.

Abundance and/or indices of abundance were estimated for 23 lake resident populations in interior Alaska. Abundance of fully recruited (> 450 mm) burbot was greatest in Paxson Lake (3,920) and most dense in Tolsona Lake (10.6 fish per hectare). Survival between years ranged from 35.2 to 82.4 % per year for populations in Paxson, Fielding, Louise, and Tolsona Tyone and Round Tangle lakes. Preliminary estimates of sustainable yield are provided for some populations.

Ridder, W.P. 1989a. Age, length, sex, and abundance of Arctic grayling in the Goodpaster River, 1956 through 1988. Alaska Department of Fish and Game. Fishery Data Series No. 94. 49 pp.

Estimated population abundance in the lower 48 km of the river was 7,638 fish greater than 149 mm fork length. All historical data on age and size compositions, harvest and effort, and population abundance from 1955 to 1987 were compared. The data show recruitment to the population to be quite variable and similar to other riverine stocks of interior Alaska.

Ridder, W.P. 1989b. Age, length, sex, and abundance of Arctic grayling in Mineral Lake Outlet, 1969-1988. Alaska Department of Fish and Game. Fishery Data Series No. 87. 36 pp.

Fish were captured by beach seine during spawning. Temporal changes in age, size, and sex compositions were noted during sampling. Length at maturity and

size composition of the spawning stock was significantly less than that found in two spawning stocks located 282 km downstream.

Ridder, W.P. 1989c. Age, length, sex, and abundance of Arctic grayling in the Richardson Clearwater River and Shaw Creek, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 120. 35 pp.

Population abundance in the Richardson Clearwater River was estimated at 4,599 fish greater than 250 mm fork length, and at Shaw Creek, 6,080 fish greater than 270 mm fork length.

Skaugstad, C. 1988. Abundance and age-sex-size composition of the 1988 Salcha River chinook salmon escapement. Alaska Department of Fish and Game. Fishery Data Series No. 75. 30 pp.

The 1988 spawning escapement in the Salcha River was estimated, using mark-recapture methods, to be 4,562 chinook salmon (1,525 females and 3,037 males). Aerial survey abundance estimates counted 61% of the mark-recapture estimate. Egg production for the 1988 spawning run was estimated at 16.2 million eggs.

Skaugstad, C. 1989. Evaluation of Arctic grayling enhancement: A cost per survivor estimate. Alaska Department of Fish and Game. Fishery Data Series No. 96. 68 pp.

Estimates of cost per survivor at age 1 were $0.82 and $0.70 for Arctic grayling stocked as sac fry and 4 g fingerlings, respectively. It was recommended that 4 g fingerlings be stocked.

Timmons, S.L. and G.A. Pearse 1989. Abundance of the northern pike populations of George, Volkmar, and T Lakes with estimates of age, sex, and length composition, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 115. 36 pp.

Estimated abundance of fish over 299 mm fork length, during May 1988, was 23,381 and 465 fish for George and T lakes, respectively. Data on relative stock density are presented and exploitation rates are discussed.

AREA FISHERY REPORT

Harvest and Effort in 1988

The sources of harvest information for AYK Region sport fisheries, include the "Alaska Statewide Sport Fisheries Harvest Report" (Mills 1989) and creel census studies on specific AYK fisheries, conducted by area personnel (summarized by Baker, 1989a).

Creel census information in 1988 provided estimates of catch, effort, HPUE and CPUE, as well as age and size composition of the catch. Some creel census studies solicited angler opinions concerning fishing quality, or choice of regulatory and management options being considered for a particular fishery. The creel census program was designed to monitor both the fishery and the fish

populations, aid in the development of regulations that ensure sustained yield, and assess the effect of regulations on the fishery and fish stocks.

During 1988, creel censuses were conducted on seven fisheries within the Tanana River drainage and one each in Prudhoe Bay and the Seward Peninsula. A summary of the estimated harvest, CPUE, total effort and dates of the creel census by water body appears in Table 8. Angler demographics and angler opinions about the fisheries and their management were also recorded for all fisheries.

Creel censuses were conducted in four Arctic grayling fisheries in 1988. The 1988 sport harvest estimates in two of the largest fisheries in the Tanana drainage (upper Chena River, and the Delta Clearwater River) were 1,583 and 3,330 Arctic grayling, respectively. The record low harvest in the Chena River (in 1988) was partly due to more restrictive regulations, implemented in the spring of 1987. They included a prohibition against retention of Arctic grayling on the entire Chena River until after the first Saturday in June, a bait restriction and a 305 mm (12 in) minimum length on all retained Arctic grayling. Identical regulations were in effect on the Delta Clearwater River, however the 1988 harvest of 3,330 Arctic grayling (Table 8) was significantly larger than in 1987 (1,838 fish) and 1986 (1,701 fish). A significant amount of catch-and-release fishing was practiced in the upper Chena River, where 6,714 Arctic grayling were caught but only 1,583 (24%) were actually harvested in 1988 (Baker 1989a).

Estimated harvest (4,456 fish) and CPUE of least cisco in the Chatanika River fall spear fishery in 1988 was significantly less than in 1987 (harvest estimate: 23,735 fish) and 1986 (harvest estimate: 16,575 fish), although effort levels were similar. The harvest reduction is in part due to the bag limit of 15 whitefish per day, enacted by the Board of Fisheries for the first time in 1988. Prior to 1988, no harvest limits were imposed. The humpback whitefish harvest estimate in 1988 (3,571 fish) was less than in 1987 (4,577 fish) but larger than in 1986 (2,528 fish).

The 1988 Salcha River chinook salmon harvest estimate of 19 fish was smaller than in 1986 (526 fish) and 1987 (111 fish). Chinook salmon fishing was restricted to the lower 8 km of the river in 1988 for the first time. Prior to 1988, fishing was allowed throughout the lower 23 km. Estimates of population size (Skaugstad 1988) indicated that escapement was similar to that estimated in 1987, even though sport fishing effort was estimated to be approximately half that in 1987 (Baker 1988, 1989). Aerial surveys conducted in July indicated that minimum spawning escapement objectives (1,500 chinook salmon on an aerial survey) had been achieved as of 20 July.

A creel survey of the sport fishery targeting anadromous Dolly Varden on the north slope at Prudhoe Bay's West Dock facility was conducted for the first time in 1988 (Baker 1989). The survey was a cooperative effort between Habitat Division and Sport Fish Division of ADFG. A harvest of 116 Dolly Varden was estimated for the summer season.

The statewide postal survey, compiled annually since 1977 by Mills (1979-1989) serves as the basic reference of effort and harvest in AYK Region fisheries.

Table 8. AYK Region creel surveys, 1988.

Water Body/Fishery	Species[a]	Date(s)	Effort (hours)	CPUE	Harvest
Chatanika River campground	LC	9 Sept-16 Oct	2,237	0.630[b]	1,416
Chatanika River ditch	LC	9 Sept-16 Oct	1,440	2.110[b]	3,040
Chatanika River campground	HW	9 Sept-16 Oct	2,237	0.640[b]	1,437
Chatanika River ditch	HW	9 Sept-16 Oct	1,440	1.110[b]	1,603
Chatanika River Steese Hwy	HW	9 Sept-16 Oct	297	1.790[b]	531
Chena River	GR	14 May-18 Sept	11,763	0.570	1,583
Chena River	KS	02 Jul--29 Jul	8,544	0.090	567
Delta Clearwater River	GR	04 Jun-05 Sept	4,433	1.340	3,330
Piledriver Slough	RT	16 Apr- 9 Sept	ND	1.920	ND
Piledriver Slough	GR	16 May- 9 Sept	ND	1.330	ND
Salcha River	KS	02 Jul- 24 Jul	4,398	0.004	19
Salcha River	CS	02 Jul- 24 Jul	4,398	0.005	11
Tangle Lakes and River	GR	4 Jun- 5 Sept	ND	1.070	ND
Prudhoe Bay	DV	11 Jul- 5 Aug	234	0.790	116

[a] CS: chum salmon; GR: Arctic grayling; HW: Humpback whitefish; KS: chinook salmon; LC: least cisco; RT: rainbow trout; DV: Dolly Varden char

[b] Harvest per unit effort

Many important Tanana drainage fisheries are not monitored by Department creel surveys, and several are monitored only to the extent that CPUE and biological catch composition data are collected, but not seasonal harvest totals. Because so few fisheries can be monitored by creel survey, the statewide survey is the only source of harvest information. Comparison of available harvest estimates from creel surveys with those from the statewide survey, (Table 9) indicates that the two types of harvest estimates produced similar results except for the Salcha and Chena rivers salmon fisheries.

Most harvest and effort data presented in this report are based upon the Alaska Statewide Sport Fish Harvest report (Mills 1989). Survey estimates are based upon responses to postal surveys sent to a random sample of resident and nonresident Sport Fish license holders. Approximately 4% of all sport fishing license holders are surveyed annually, and in 1988, a total of 13,697 questionnaires were mailed, followed by two reminders to non-respondents. Responses were obtained from more than 56% of the individuals that received the first mailing.

Results of the 1988 harvest report for the Tanana River drainage fisheries were based on responses received from a total of 1,505 people (Mills 1989). In 1988, Tanana Area anglers accounted for 81% and 10% of the total number of all anglers in the AYK Region and the entire state of Alaska, respectively (Table 10). Of the 1,457,934 fish harvested in freshwater (includes anadromous salmonids) in the state, 198,533 (14%) were taken from the Tanana drainage, and 65,818 (5%) were taken from the AYK Area (Table 10).

Mills (1989) estimated annual harvests for 19 separate locations within the Tanana drainage (Table 1). Statewide harvest survey results for 1988 for sub-areas within the AYK Area are summarized in Tables 3 through 7.

MANAGEMENT ACTIVITIES

1988 In-Season Regulatory Measures

Fisheries research studies initiated in 1984 and 1985 resulted in a number of regulatory changes that became part of the permanent regulations in 1988.

Emergency Orders and Regulations:

The Alaska State Legislature, in enacting AS 16.05.060, delegated to the Commissioner and his authorized designees the power to control certain aspects of public utilization of fish and game. In 1988, statutory authority for emergency orders was limited to opening and closing fishing seasons or areas. Emergency orders could not be used to establish or change quotas, bag limits, size limits or gear restrictions, among other things. Emergency orders have the same force and effect as regulations of the Boards of Fisheries and Game, or statutes enacted by the Legislature, and they carry the same criminal penalties if violated. An emergency order remains effective until rescinded, superseded by a subsequent emergency, and/or unless an expiration date is specified (ADFG 1983). Use of emergency order authority allows the ADFG to take regulatory action in response to unexpected conservation problems. Sport

Table 9. Comparison of 1988 Alaska Sport Fish Survey and Tanana River drainage creel survey harvest estimates.

Fishery	Creel survey	Harvest survey[a]
Upper Chena River		
Arctic grayling	1,583	1,896
Delta Clearwater River		
Arctic grayling	3,330	2,910
Chatanika River		
whitefish	8,027	7,983
Salcha River		
chinook salmon	11	236
chum salmon	19	55
Chena River		
chinook salmon	567	73[b]

[a] Statewide sport fish harvest survey (Mills 1989).
[b] Anadromous chinook salmon less than 406 mm (16 in) in length

Table 10. Number of sport anglers, fishing trips, angler days and total freshwater[a] fish harvested in the Tanana River drainage, AYK and the entire state of Alaska, 1988[b].

	Tanana Drainage	AYK[c]	Alaska
Number Sport Anglers	36,911	8,695	377,004
Number Fishing Trips	151,923	32,464	1,919,286
Number Angler Days	174,554	59,005	2,311,291
Total Fish Harvested	198,533	65,818	1,457,934

[a] Includes anadromous salmonids.
[b] Mills 1989.
[c] Exclusive of Tanana River drainage.

fisheries in the AYK Region generally proceed under the published basic regulations.

A number of regulatory changes were enacted during the 1987 calendar year, some by the emergency regulation process, the majority through action by the Alaska Board of Fisheries. A full discussion of regulation development in 1987 may be found in Arvey et al. (1990b). Action by the Board of Fisheries on finfish proposals for the AYK Region is scheduled to occur only in alternate years. Since full consideration was given in 1987 to proposals from the region, there was no scheduled Alaska Board of Fisheries meeting to consider changes in sport fish regulations in 1988. No emergency regulations were enacted in 1988. The following AYK Region Emergency Order was issued in 1988:

> 3-S-Z-11-88. Closed the Nome River to the taking of chum salmon from July 13 through December 31, 1987. Issued at Nome July 13, 1988.

News Releases, Announcements, and Articles:

Four news releases (also called field announcements) concerning AYK Region sport fisheries were issued by the Department in 1988. They are listed below.

1. February 23, 1988. Board of Fisheries enacts new sport fishing regulations for the Tanana River drainage area. Changes to sport fishing regulations enacted by the BOF in 1987 are described for Tanana Area sport fisheries.

2. February 23, 1988. Board of Fisheries enacts new sport fishing regulations for the Arctic-Yukon-Kuskokwim Area. Changes to sport fishing regulations enacted by the BOF in 1987 are described for AYK Area sport fisheries.

3. May 18, 1988. State to stock kokanee and Arctic char in Harding Lake. Experimental stocking of sockeye salmon from the Gulkana Hatchery and Arctic char from Bristol Bay into Harding Lake in June 1988 is described.

4. May 18, 1988. Lake stocking program to begin experiments with Arctic char, kokanee and lake trout. Plans for an interior lake stocking program in the Tanana River drainage are presented in this news release.

Five news articles concerned with AYK Region sport fisheries appeared in major Alaska newspapers in 1988. They are listed below.

1. April 15, 1988. Walleye in Alaska waters? Now's time, say residents. By: Christopher Batin, Fairbanks Daily News Miner (FDNM). The proposed stocking of interior lake waters with walleye imported from the lower 48 states is discussed, with both pro and con positions stated.

2. February 25, 1988. New sportfish rules hit salmon, grayling anglers among others. By: Christopher Batin FDNM. New regulations passed by the BOF in December, 1987 for sport fishing in the AYK and Tanana Areas are presented and discussed with comments from staff and representatives from outdoor groups.

3. 1988. Quartz due for $700,000 in dock, parking improvements. By: Kathi Berry FDNM. A description of the new facilities at Quartz Lake, scheduled to begin in fall of 1988 using D-J access program money is presented.

4. September 22, 1988. The pike picture. By: Kelly Bostian FDNM. The article discusses the ADFG program for northern pike in Minto Flats, staff concern for conservation and sport fishing overharvest.

5. September 22, 1988. It's time for spearing whitefish. No byline. This is a short article that discusses how the public may participate in the Chatanika River whitefish spearfishery.

Preseason and Post-Season Regulatory Activities

The process of developing appropriate fishing regulations continues each year both during the primary fishing seasons, as well as before and after. The following section describes the salient features of that process in 1988.

Advisory Committees:

Public input concerning regulation changes is provided by several means, including direct testimony to the Board of Fisheries and by participation in local fish and game advisory committees. Local advisory committees have been established throughout the state to assist the Boards of Fish and Game in assessing fisheries issues and proposed regulation changes in the areas that will be affected. Most active committees meet at least once a year, usually in the fall prior to the Board of Fisheries meeting. Advisory meetings allow opportunity for direct public interaction with Department staff who are expected to attend, answer questions, and provide clarification concerning proposed regulatory changes.

Active advisory committees for the AYK Region during 1988 included the following: Central Bering Sea, Lower Kuskokwim, Central Kuskokwim, Lower Yukon, Western Arctic, Eastern Arctic, Norton Sound, Southern Norton Sound, Kotzebue, Northern Seward Peninsula, Upper Kobuk, Lower Kobuk, Noatak/Kivalina, McGrath, Tok Cutoff/Nabesna Road, Clear/Healy, Delta, Denali, Upper Tanana/Fortymile, Yukon Flats, Fairbanks, Tanana, Ruby, Middle Yukon, Koyukuk, Grayling/Anvik/Shageluk/Holy Cross, and Eagle.

Several of the committees did not meet to discuss fisheries issues in 1988. Sport Fisheries Division staff participated in meetings of the Fairbanks and Delta committees in 1988. Sport fisheries issues in Nome, Kotzebue, and in the lower Yukon and Kuskokwim River areas were handled by Division of Commercial Fisheries staff attending those respective meetings.

Alaska Board of Fisheries:

The Board of Fisheries (BOF) met in March 1988, to consider commercial, sport and subsistence finfish proposals from the Kodiak, Alaska Peninsula, Cook Inlet, and Prince William Sound areas. The Board of Fisheries held a public hearing on subsistence and commercial salmon fishing in the Tanana River on May 28-31. Sport fishing regulations were not discussed at this special meeting. Because of the alternating years schedule that has been adopted by the BOF, AYK Region sport fish proposals were not considered in 1988.

AYK Sport Fishing Regulations:

Revisions adopted to the regulations in 1987 were implemented during 1988. Published regulations for 1988 are reproduced as Appendix B.

AYK SPORT FISHERIES ENHANCEMENT

Interior Alaska Lake Stocking Program

Selected lakes and ponds of the Tanana River Valley are stocked on a continuing basis with rainbow trout, coho salmon, Arctic grayling, chinook salmon, sheefish, lake trout, sockeye salmon, and Arctic char. Resulting fisheries composed a minimum of 40% of the recreational angling effort in the Tanana River drainage in 1988 (Table 1). By providing stocked fish in the Tanana River valley, the ADFG hopes to:

1. ease harvest pressure on wild stocks;
2. provide increased angling opportunity for increasing numbers of anglers; and,
3. diversify angling opportunity.

Lake stocking in the Tanana River valley takes place over an approximate 130,000 km^2 area, most near communities and along the road system, but also in a number of remote locations accessible only by off-road vehicle (ORV), dog team, or airplane. About half of the yearly sport effort on stocked lakes takes place during the winter on larger accessible lakes.

ADFG stocking in the Interior began in the mid-1950's when barren lakes along the road system were stocked with rainbow trout or salmon. Between 1968 and the early 1980's, 15 lakes (including Birch and Quartz lakes) were chemically treated to eradicate endemic fish populations (Doxey 1987).

Throughout the 1970's, hatchery ability to provide stocked fingerlings steadily increased as fisheries enhancement received growing emphasis. Native Alaska rainbow trout brood stocks were developed when the importation of eggs from outside the state was discontinued in the late 1970's. As suitable brood stocks were developed and new hatcheries were put into production, numbers of available stocked fish increased so that by 1985, average annual harvest and effort levels for stocked waters had risen by more than 40% and 20%, respectively (Doxey 1987).

The growth and success of the interior Alaska stocking program has been largely due to the development of, and production from, Alaska state hatcheries, particularly the Clear Hatchery, located about 145 km south of Fairbanks at the Clear Air Force Station (Figure 8). The Clear hatchery program began in 1977, with an initial mission to experimentally incubate, rear and release chum salmon to determine whether large scale enhancement of salmon would be feasible under conditions found in the Interior. In recent years, production of sport fish species has taken precedence over anadromous salmonids, and a large proportion of its output consists of fingerling and sub-catchable rainbow trout, coho salmon, and Arctic grayling. The facility presently has a capacity of about 9.0 million eggs.

Success of the stocking program is evaluated annually. The level of evaluation varies according to the size and accessibility of the lake and the importance and intensity of the sport fishery. Minimal evaluations address the question of whether the stocked fish survived and are providing sport fishing. More comprehensive evaluations provide limnological data, growth rate data, and fishery statistics such as CPUE, population estimates, comparison of performance between species, and other parameters.

1988 Stocking Results

Approximately 2.56 million fish of eight species were stocked in area waters in 1988, of which 759,626 were rainbow trout. By comparison, 3.3 million fish were stocked in the area in 1987, of which 1,876,000 were rainbow trout. The size at stocking of fingerling rainbow trout was reduced from approximately 2.0 g to 1.0 g in 1988 and the region request for rainbow trout fingerling was reduced from 1,000,000 to 500,000 fish due to increased availability of larger rainbow trout and fish of other species.

Most of the stocked rainbow trout in 1988 were fingerling (approximately 1.0 g) or sub-catchable (20 to 30 g) sized fish reared at Clear Hatchery, but about 61,000 were of catchable size (65 to 135 g) reared at the Fort Richardson Hatchery in Anchorage (Table 11). All of the rainbow trout were of the Swanson River (Kenai Peninsula) strain.

Rainbow trout were stocked into Piledriver Slough for the first time in 1987, with the release of 12,500 catchable size (100 to 155 g), 12,500 sub-catchable (26.0 g) size and 35,000 fingerling (2.0 g) sized fish. Observations and catch returns in April and May 1988 indicated that large rainbow trout stocked in 1987 overwintered in, or returned to Piledriver Slough (Doxey 1989). Natural reproduction in the slough was not documented. Stockings of all three size cohorts continued in 1988.

Approximately 1,351,392 fry-sized, fingerling, and catchable-sized Arctic grayling were stocked in area lakes, ponds and pits in 1988, all of Moose Lake (Susitna River drainage) brood stock. These fish were incubated and reared at the Clear Hatchery (Table 12). Sheefish have been experimentally stocked in Tanana Area lakes and ponds for several years to determine whether such an enhancement effort would be feasible for this species. About 60,000 sheefish were stocked in Harding Lake in 1988 (Table 12). Based upon poor survival of

Table 11. Number and size of rainbow trout stocked in AYK waters in 1988.

Receiving Water	Number Stocked	Size (g)
Backdown Lake	1,200	1.1
Bathing Beauty Pond	350	1.1
Birch Lake	10,000	30.0
Birch Lake	44,723	24.0
Bullwinkle Lake	800	1.1
Chena Lake	30,091	90.0
Chet lake	1,600	1.1
Doc Lake	520	1.1
Dune Lake	10,000	1.1
Earthmover Pit	1,000	1.3
Firebreak Lake	2,000	1.1
Four Mile Lake	20,000	1.3
Geskamina Lake	5,000	1.3
Ghost Lake	1,000	1.1
Grayling Lake	1,000	1.1
Harding Lake	248,658	1.3
Hidden Lake (EAFB)	1,800	90.0
Jan Lake	8,800	1.1
Johnson Road Pit # 1	2,000	1.1
Ken's Pond	1,000	1.1
Koole Lake	30,000	1.3
Les's Lake	750	1.3
Little Harding Lake	3,600	1.1
Lost Lake	4,700	1.1
Manchu Lake	2,900	1.1
Mark Lake	4,000	1.1
Moose Lake	2,254	90.0
Nickle Lake	1,000	1.1
No Mercy Lake	1,500	1.1
North Twin Lake	4,000	1.1
Piledriver Slough	26,554	65-135.0
Piledriver Slough	17,927	22.0
Piledriver Slough	35,000	1.1
Quartz Lake	48,094	25.0
Quartz Lake	150,000	1.1
Rainbow Lake	20,000	1.3
Rapids Lake	2,000	1.1
Robertson 2 Lake	1,600	1.1
Rockhound Lake	600	1.1
Sansing Lake	500	22.0
South Twin Lake	4,000	1.1
Spenser Lake	5,000	28.0
Thirty-one mile Richardson Pit	500	1.1
Weasel Lake	1,600	1.1
Total	759,626	

Table 12. Number and size of Arctic grayling and sheefish stocked in AYK waters in 1988.

Receiving Water	Number Stocked	Size(g)
Arctic grayling		
Bathing Beauty Pond	350	2.7
Bolio Lake	20,000	0.02
Dune Lake	5,000	2.4
Earthmover Pit	324	105.0
Firebreak Lake	2,000	2.4
Harding Lake	1,169,806	0.02
Hidden Lake (EAFB)	10,000	0.02
Luke Lake	700	4.0
Sansing Lake	684	60.0
Sansing Lake	128	125.0
Sheefish Lake	800	4.0
Triangle Lake	80,000	0.02
Walden Pond	15,000	0.02
Johnson Road Pit # 1	10,000	0.02
Steese Hwy Pits:		
Mi. 29.6	1,000	3.4
" 30.6	1,000	3.4
" 33.0	10,000	0.02
" 33.5	10,000	0.02
" 34.6	800	3.4
" 35.8	1,000	3.4
" 36.8	1,000	3.4
Chena Hot Springs Rd Pits:		
Mi. 32.9	1,000	3.4
" 45.5	10,000	0.02
" 47.9	800	3.4
Subtotal Arctic grayling	1,351,392	
Sheefish		
Harding Lake	60,000	0.015

stocked cohorts, sheefish stocking has been judged to be ineffective and 1988 was the last year of the program.

Arctic char stockings into the Coal Mine Road lakes were judged to be successful, and fish were expected to grow to catchable size by 1989. Growth rates of Arctic char in the hatchery were high, prompting an increase in production. Twenty-one area waters were experimentally stocked with 27,370 fingerlings at 4.2 g. Harding Lake was stocked with 30,820 Arctic char (50 g) in the fall of 1988 (Table 13). Lake trout enhancement in 1988 consisted of the experimental stocking of 38,476 fish of Paxson Lake stock, averaging 4.1 g, into 17 area waters to test the potential of this species for interior Alaska stocking (Table 13). They were stocked in a variety of habitats, from roadside gravel pits to small, high elevation lakes.

Chinook salmon fingerlings (55,985 at 8.7 g) were stocked in 1988 in lakes of the Tanana Area (Table 14). The fry, (which were of Crooked Creek, Kenai Peninsula stock) were reared in the Elmendorf Hatchery and subsequently released in the Interior. Harding Lake was stocked experimentally for the first time with 500,000 sockeye salmon fry from the Gulkana Hatchery (Table 14). A total of 38,476 coho salmon was stocked in Tanana Area lakes and ponds in 1988 (Table 14). Stocked coho salmon were of fingerling (4.1 g) size. All released coho salmon were of Wood Creek (Nenana River) stock, and all were reared at Clear Hatchery.

Anadromous Fish Releases by State Hatcheries

In addition to anadromous species stocked to landlocked lakes in the Tanana drainage, salmonids reared at the Clear Hatchery were stocked into flowing waters of the Tanana River with the intent of enhancing anadromous salmon returns. Only coho salmon of the Wood Creek (Nenana River) stock were released in 1988. A total of 277,108 coho salmon of Wood Creek stock were released in the Tanana River drainage in 1988. All open water releases took place in tributaries to the Nenana River. Released salmon ranged in length from 40 to 70 mm and in weight from about 0.6 to 3.9 g. The released fish were from the 1987 brood year.

The other state operated hatchery in the AYK Region was initiated in 1980 in the Kotzebue area at Sikusuilaq Creek, approximately 50 km upstream from the mouth of the Noatak River (Figure 15). The initial purpose of the facility was to examine the feasibility of large-scale chum salmon enhancement in a far northern environment. Hatchery expansion starting in 1987 is intended to bring the facility into larger scale production than in prior years of feasibility testing. Enhanced hatchery returns are intended to benefit the salmon gill net fishery which operates near Kotzebue in marine waters. The scale of salmon releases has been relatively small, less than two million chum salmon fry prior to 1988. Returns from prior year releases have been identified both in the commercial fishery and at the hatchery. Releases of chum salmon fry in the lower Noatak River in 1988 totalled 3,500,000 fish at an average size of approximately 0.5 g. Returns of about 20,000 adult chum salmon were identified from hatchery releases in 1983-1985. Expanded hatchery capability was initiated in 1987 with the installation of new egg and fry incubators in order to increase rearing capacity to 10 million eggs. In

Table 13. Number and size of Arctic char and lake trout stocked in AYK waters in 1988.

Receiving water	Number Stocked	Size (g)
Arctic char		
Backdown Lake	1,200	4.2
Bathing Beauty Pond	350	4.2
Brodie Lake	1,000	4.2
Dick's Pond	1,000	4.2
Doc Lake	520	4.2
Grayling Lake	1,000	4.2
Harding Lake	30,820	50.0
Ken's Pond	900	4.2
Last Lake	500	4.2
Little Harding Lake	3,600	4.2
Lost Lake	4,700	42
Luke Lake	600	4.2
Manchu Lake	2,900	4.2
North Weigh Station Pond	1,000	4.2
South Weigh Station Pond	1,000	4.2
32.9 mi. Chena Hot Springs Rd. Pit	1,000	4.2
28 mi. Richardson Hwy. Pit	800	4.2
31 mi. Richardson Hwy. Pit	800	4.2
30.6 mi. Steese Hwy. Pit	1,000	4.2
36.8 mi. Steese Hwy. Pit	1,000	4.2
Rangeview Lake	900	4.2
Weasel Lake	1,600	4.2
Subtotal Arctic char	58,190	
Lake trout		
Bolio Lake	14,900	4.1
Chet Lake	1,600	4.1
Paul's Pond	1,000	4.1
Coal Mine Pond #5	2,600	4.1
Ghost Lake	1,000	4.1
Grayling Lake	1,000	4.1
Lost Lake	2,526	4.1
Luke Lake	800	4.1
Nickel Lake	1,000	4.1
Rockhound Lake	600	4.1
Sheefish Lake	800	4.1
Triangle Lake	6,500	4.1
Silver Fox Pit	1,200	4.1
47.9 mi. Chena Hot Springs Rd. Pit	800	4.1
Bathing Beauty Pond	350	4.1
29.6 mi. Steese Hwy Pit	1,000	4.1
34.6 mi. Steese Hwy Pit	800	4.1
Subtotal lake trout	38,476	

Table 14. Number and size of coho salmon, sockeye salmon, and chinook salmon stocked in AYK waters in 1988.

Receiving water	Number Stocked	Size (g)
Coho Salmon		
28 Mile Richardson Hwy. Pit	800	3.3
Birch Lake	40,000	3.4
Chena Lake	15,000	3.3
Earthmover Pit	1,000	3.2
Eight Mile Lake	15,000	3.2
Hangar Pit	2,600	3.2
JRP #1	500	3.2
Long Pond	700	3.2
Lost Lake	4,700	3.4
Manchu Lake	2,900	3.3
Moose Lake	10,000	3.3
Quartz Lake	150,000	3.4
Round Pond	400	3.2
Sansing Lake	200	3.2
Sockeye Salmon		
Harding Lake	500,000	fry
Chinook salmon:		
Bolio Lake	13,130	8.7
Chena Lake	32,855	8.7
Donnelly Lake	6,400	8.7
Little Harding Lake	3,600	8.7
Subtotal: coho salmon	243,800	
sockeye salmon	500,000	
chinook salmon	55,985	

addition, new raceways were installed to allow short term rearing of fry before release.

LAND USE, HABITAT AND WATER QUALITY

Habitat-Related Fisheries Issues

Commercial development of minerals and timber, and construction of highways, can have significant impacts on watersheds as well as fish. The following is a brief description of the types of commercial development in the Tanana and AYK Areas, and known fisheries impacts.

Placer Mining:

The majority of Alaska's placer mining takes place in the AYK Region. Placer mining effluents, if not controlled, have the potential to significantly alter stream habitats and to impact fish populations. Elevated stream turbidity and sediment loads may reduce oxygen exchange rates through abrasion of gill tissues, prevent foraging by sight feeding fishes, limit aquatic plant growth by displacement or smothering, and generally reduce abundance and/or diversity of aquatic macroinvertebrates important for fish production (Weber 1986). Placer mining activities may also increase the toxic metal content (arsenic, mercury) of stream water (ADEC 1986). In addition to changes in water quality, placer mining can affect the physical characteristics of the streambed by altering channel flow and modifying riparian habitat. Tailing deposits can inhibit fish passage and decrease overwintering habitat.

In Alaska in 1988, 11,848 new mining claims (on state, private and federal lands) were recorded by the Alaska Department of Natural Resources (ADNR), a receiving agency for state and federal mining permits (Green et. al. 1989). The number of claims recorded in 1988 represents an increase of 30% over 1987 recordings. The total number of active claims on file in 1988 (75,542) exceeded the number of claims on file in 1986 and 1987. The ADFG issues permits for mining in streams supporting anadromous and resident fish per its Alaska State Statutes Title 16 authority. In some cases, where development is within a resident fish stream and will not block fish passage, or where fish are not present, permits may not be required.

Gold production increased in 1988 for the second straight year from 8,660 kg (229,000 troy oz) in 1987 to more than 10,000 kg (265,000 troy oz) for the entire state (Bundtzen et al. 1988, Green et. al. 1989). The majority of the gold operations were placer mines (208), with the remainder (3) consisting of lode operations (Green et. al. 1989). Expanded operations at several large projects is considered responsible for expanded production. Green et al. (1989) report that 10 operations produced 59% of the statewide total of gold bullion in 1988. The number of mechanized placer mines, which are the main producers of gold bullion, increased only marginally from 1986.

The U.S. Environmental Protection Agency (EPA) issued placer mining effluent guidelines in 1988, which had been under consideration since 1986. Guidelines go into effect in 1989 for water discharge permits, and will require 100%

recycling of mine process waters, in addition to placing certain restrictions on the use of hydraulic mining technologies. Certain "best practice" mining methods are recommended in the guidelines.

A 1987 lawsuit by the Sierra Club against Bureau of Land Management (BLM) resulted in a federal injunction halting mining on claims that disturb more than 2.02 ha (5 ac) of land in the Birch Creek, Fortymile River, Beaver Creek, and Minto Flats drainages until BLM completes cumulative environmental impact assessments for those lands (Bundtzen et al. 1988). BLM completed draft environmental impact statements (EIS) for the four drainages in 1988. In late 1988, a preferred alternative was identified for Beaver Creek that permitted placer mining to continue in 1989, however the lifting of the injunction will require federal court action.

The U.S. Army Corps of Engineers, beginning in 1988 required much more detailed information in permit applications from Alaska mine operators than had previously been required. Wetlands permits issued by the Corps to placer miners included stipulations for land reclamation, stream reconstruction, settling pond design, and location of road and mine facilities (Green et. al. 1989).

The State of Alaska has had turbidity standards for mine water discharge since the early 1970's and since 1986, settling ponds have been required to reduce turbidity in receiving waters. Bundtzen et al. (1987) reported that in 1986 most miners were not in compliance with state law, but improvements were noted in 1987 (Bundtzen et al. 1988). The Alaska Department of Environmental Conservation (ADEC) adopted new mixing zone water quality regulations in 1988 that may assist placer miners in complying with state turbidity standards.

The National Park Service (NPS) will issue EIS's on mining in Alaska's national parks where mining has been halted since 1985.

A draft EIS was completed in 1988 for the lease sale of federal submerged lands in Norton Sound for mining of gold and other minerals adjacent to tracts already under lease to Westgold Inc. for an offshore bucketline dredge. Final EIS is expected in May 1989, and if the sale is to proceed, the lease sale would take place in 1990.

Gravel Mining:

There are few documented instances where gravel mining in AYK has affected fish populations. Gravel mining of a streambed has the potential to cause instream fanning, erosion, and deterioration of water quality and fish habitat (ADEC 1986). A complete listing of gravel mining sites and impacted streams is available in ADEC (1986). Green et al. (1989) contains a listing of gravel mine operations in 1988. Reclamation of 19 gravel mine pits in the Prudhoe Bay area of the North Slope has increased overwintering habitat for fish inhabiting connecting streams, and increased fish production (Hemming 1988).

Industrial Metals Development:

Offshore dredging for gold in Norton Sound by the 'Bima' (world's largest bucketline dredge owned by Western Gold Exploration and Mining Co.) was conducted from 10 June through 14 November 1988 and recovered 1,343 kg (35,500 troy oz) of refined gold. This operation was the state's second largest gold producer in 1988 (Green et al. 1989). Environmental effects of this operation on nearshore habitats and fisheries in the Nome area have been monitored by industry consultants, and the results of monitoring efforts are reviewed by agencies at regular intervals.

Construction activities at the Red Dog Mine in the headwaters of the Wulik River north of Kotzebue brought the project to the 60% completion stage. In October 1986 the COMINCO Board approved development of the zinc-lead-silver deposit, with production scheduled for 1990, following road and port development. During the construction phase, workers have been prohibited by contract with NANA Corp. from participating in sport or subsistence fishing and hunting. Thus, the influx of workers has not impacted the harvest of fish near the construction area. Road and culvert construction was closely monitored by ADFG Habitat Division personnel, and no lasting impacts to fish are believed to have occurred[3]. Impacts to Dolly Varden char populations in the Wulik River and it major tributary Ikalukrok Creek would occur if containment of the mine tailings pond failed and heavy metals washed into the Wulik River drainage through Red Dog Creek.

Oil and Gas Development:

Oil and gas extraction activities in the AYK Region are presently restricted to the North Slope. North Slope development has affected fish habitat on and near transportation corridors (such as the Dalton Highway and the Trans Alaska Pipeline) and by the extraction of gravel for road and building construction and maintenance. There is evidence that construction of Prudhoe Bay's West Dock Causeway has disrupted east and west migratory movements as well as recruitment of Arctic cisco in the Colville and Sagavanirkok rivers (Gallaway et al. 1987; Moulton et al. 1986). Documentation of oil spills and resulting adverse impacts (if any) on fish populations from contamination is lacking in the AYK Area. A number of studies throughout the 1980's have tried to determine or predict impacts from offshore gravel causeways, such as the Endicott Causeway, in the Beaufort Sea to fish, fisheries and fisheries habitat.

Timberland Development:

Logging had no significant impact to fisheries resources in the AYK Region in 1988. Little commercial logging presently occurs in the region. The largest commercial timber harvests in the Kuskokwim Basin occur from McGrath to Stony River (ADNR 1988). Some commercial logging of spruce currently occurs in the Tanana River basin, primarily on state owned land along the Tanana River.

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[3] Matt Robus. 1988. Personal Communication. ADFG, Division of Habitat, 1300 College Rd., Fairbanks, AK 99701.

Road construction associated with logging could impact fish populations by accelerating the rate of soil erosion and sedimentation in streams, however, because of the minimal level of industry development at the present time, no such problems have been identified in the region.

Highway Development:

Roads allow increased access to streams and lakes, thereby increasing the utilization of sport fishery resources. Improperly designed or constructed road culverts can create partial or complete barriers to fish migration. Major highways in the AYK region include the Steese Highway which accesses the Yukon River and Birch Creek; the Taylor Highway leading to the Forty-Mile and Yukon rivers; the Parks and Richardson Highways which provide access to the Tanana River and many of its tributaries and lakes; the Dalton Highway to the North Slope which crosses the Yukon River, upper tributaries of the Koyukuk River and the Sagavanirktok and Kuparak rivers on the North Slope. A newly-constructed road north of Kotzebue connects the Red Dog Mine in the headwaters of the Wulik River to the Chukchi Sea coast south of Kivalina. The Seward Peninsula has three major roads which cross more than a dozen rivers important for sport fishing. Of the road systems in AYK, culvert crossing on the Dalton, Red Dog Mine and Seward Peninsula Highways have been of most concern to the Department. There are 40 - 50 culverts on the Seward Peninsula built in the 1950's of which many constitute partial barriers to tributary spawning and rearing. Habitat Division personnel are working with the Alaska Department of Transportation to improve stream habitat, for example, by removing gravel berms in the Nome and Pilgrim rivers which will provide more rearing habitat for young Arctic grayling.

Commercial Utilization of Fisheries Resources

Commercial sport fishing activities, through establishment of lodges and guiding services, offers a source of revenue to residents in the Tanana and AYK Areas. A brief description of known commercial uses of sport fish species follows.

Wilderness Lodges and Guiding:

Lodges and sport fish guiding operations (including outfitters) are significant factors in the utilization of sport fishery resources in the AYK Region, although the extent of this influence has yet to be fully determined. More information regarding the location and operation of lodges and guiding and outfitting operations is needed. A partial list of the type of operation at various locations can be found in Appendix C. The number of resident or nonresident clients served, species targeted, or types of fishing experiences offered at these locations is presently not documented.

Commercial Fisheries:

Important commercial fisheries exist for finfish and shellfish species in the AYK Region. The largest is the commercial salmon fishery, which in 1988, had a wholesale value of approximately $28.2 million. The herring and shellfish

fisheries produced approximately $5.0 million and $0.7 million worth of product in 1988 (Savikko 1989).

Commercial fisheries for finfish species other than salmon, or herring, are sometimes allowed under authority of a permit issued by the Commissioner of the Department of Fish and Game or his designee, usually an area manager of the Division of Commercial Fisheries. Permits to commercially harvest whitefish, sheefish, northern pike, blackfish, lamprey, Dolly Varden and burbot are issued occasionally for limited (usually local) commercial markets. In many cases, permits are issued by the Department, but harvests are either not made or are not reported. Only a small commercial harvest of non-anadromous finfish was reported for the AYK Region in 1988. The Division of Commercial Fisheries maintains data records of such harvests.

Commercial harvests of freshwater species in the Norton Sound and Kotzebue Area in 1988 are reported by Merkouris and Lean (1989). The harvest of sheefish from Hotham Inlet near Kotzebue takes place during winter months of two calendar years (winter of 1987-88, and fall of 1988-89). Harvest during calendar year 1988 is not reported separately but numbers reported for winter 1987-88 are 943 sheefish, and 1,544 sheefish for fall 1988-89. These figures reflect higher commercial catches than have been reported since 1981-82, but are significantly less then those reported for most years in the 1960's and 1970's. Adult Dolly Varden taken incidentally in the Kotzebue commercial chum salmon fishery are sometimes sold to commercial fish processors. A total of 752 such fish were harvested and sold in 1988, compared to 1,261 sold in 1987. The mean weight of the commercially sold Dolly Varden was 2.99 kg in 1988. No permits were issued in either the Norton Sound or Kotzebue Areas in 1988 for the harvest of whitefish or other freshwater species such as burbot or northern pike, and no sales of those species is recorded.

Francisco et al. (1989) reports that three fishermen harvested and sold 2,006 whitefish in 1988 in the Kuskokwim Area.

A fishery has taken place in the Colville River since 1964 for broad whitefish, humpback whitefish, Arctic cisco and least cisco. Reported harvests in this fishery in 1988 include: 429 broad whitefish; 6,733 humpback whitefish, 10,287 Arctic cisco, and 23,910 least cisco (Holder 1990).

Freshwater fishery permits have been issued in various years for whitefish at Healy Lake, whitefish in Lake Minchumina, and burbot in the Tanana River. A commercial harvest of 837 whitefish from the Tanana River was reported in 1988 (Holder 1990). Reported sales of freshwater species in the lower Yukon River in 1988 include 696 whitefish (Holder 1990).

Land Withdrawals, Status, and Planning

Land use designations by private owners, state, or federal agencies may affect fisheries management considerations within given land parcels. A brief description of various national land designations in the Tanana and AYK Areas and known influences on the use of sport fish within land units follows.

ANILCA:

The Alaska National Interest Lands Conservation Act (ANILCA), enacted into law in 1980, completed the implementation of the Alaska Native Claims Settlement Act (ANCSA) and addressed outstanding issues such as subsistence opportunity, energy development, economic growth and transportation planning. Legislative solutions to these issues included the creation or expansion of five national conservation systems in Alaska: national parks, wildlife refuges, wild and scenic rivers, wilderness preservation lands and national forests.

The purpose of ANILCA is to preserve for future generations certain lands and waters in Alaska, protect resources related to subsistence needs and the subsistence lifestyle for rural residents, and to protect those resources related to recreational opportunities, such as sport fishing and hunting (ANILCA 1980). The Act directs specific management guidelines for conservation system units within Alaska.

To maintain state responsibility for fish and game management on newly designated conservation system units, the ANILCA required the state to distinguish between user groups and assign priority opportunities for subsistence uses of fish and game resources.

National Parks, Monuments and Preserves:

All National Park Service (NPS) managed lands in the AYK Region are discussed under the following section.

A memorandum of understanding exists between the State of Alaska and the National Park Service (NPS) which stipulates that State fish and game regulations apply on NPS lands except when a more restrictive harvest approach is desired by NPS. NPS may promulgate regulations concerning consumptive uses of resources which are more restrictive than state laws. The ANILCA intends for NPS to provide opportunities for continued subsistence and traditional activities.

Park land designation has some influence on utilization of the sport fish resource by restricting types of development within the parks. Large scale commercial development (ie. fishing lodges) is not allowed, but small lodge facilities for a few guests have been allowed in Kobuk National Park. Construction of temporary facilities (such as fish camps or tents) on park lands in Alaska was granted under ANILCA, however the National Park Service attempted to prohibit these facilities. The state entered in a lawsuit in 1986 (unresolved in 1988) regarding cabins on park lands, to preserve temporary facility privileges. NPS goals include minimizing the sport fish take by encouraging release of captured fish or the taking of only small individuals of the more abundant species (NPS 1985a, 1986a). Motorized boat, snow machine, and airplane access is allowed for sport fishing on park lands in Alaska. Fish stocking or enhancement activities can be allowed if the purpose is to restore fish populations to "natural or healthy" levels.

Conservation system units within AYK (Figure 17) are as follows:

1. Kobuk Valley National Park is 688,000 ha (1,700,000 ac) in size and includes one wild and scenic river and 77,000 ha (190,000 ac) of wilderness. NPS has proposed an additional 168,000 ha (414,720 ac) be set aside as wilderness. Regional residents account for more than 90% of park use. NPS estimates that out-of-region recreational use is limited to about 25-75 users per year. Most out-of region visitors fly in their own planes to sport fish at the mouth of the Salmon River and other tributaries of the Kobuk River. Local boats can be chartered for fishing. Lodges in Ambler and Shungnak accommodate a small number of visitors. There are reported instances of subsistence and sport fish user conflicts on the Kobuk River (see NPS 1986a).

2. Gates of the Arctic National Park and Preserve consists of 2,939,000 ha (7,263,000 ac) of combined park and wilderness lands and 42,000 ha (103,932 ac) of park lands only. The park also includes six wild and scenic rivers. Recreational fishing is mostly for Arctic grayling, Dolly Varden and lake trout, with the most heavily used areas being Walker and Chandler lakes. Two lodges on Walker Lake, at the headwaters of the Alatna River, advertise sport fishing opportunities, and local air-taxi operators drop off anglers at other areas. Sport fishing mostly occurs in conjunction with other activities such as river running, hunting and backpacking (see NPS 1985a).

3. Cape Krusenstern National Monument was created in 1980 to protect archaeological sites, preserve prehistoric and historic Native cultures, protect habitat for fish and wildlife and protect the viability of subsistence resources. The NPS directs management of the monument which is 267,000 ha (659,807 ac) in size. Access and development restrictions of park lands apply to monument lands. Fishing for whitefish, ciscoes, Arctic char/Dolly Varden, chum salmon and northern pike is primarily by subsistence users. Recreational use of the monument is extremely limited and occurs mostly in conjunction with subsistence activities (NPS 1985b).

4. Noatak National Preserve is 2,630,000 ha (6,500,000 ac) in size, and includes one Wild and Scenic River and 2,350,000 ha (5,800,000 ac) of designated wilderness land. It is also a UNESCO Biosphere Reserve, designed to maintain genetic pools. Recreational use is estimated at 2,000 to 2,500 visitors per year, who participate in river excursions, hunting and sport fishing. Arctic grayling and Dolly Varden are the most common sport fish. About 25 commercial operators provide air and guiding service. Popular drop off points for sport fishing include the Kelly and Cutler Rivers. Construction of a State hatchery (Sikusuilaq Creek) in the Lower Noatak River has caused some concern on the part of NPS regarding maintenance of the chum salmon gene pool as expressed in the Biosphere Preserve philosophy (NPS 1986b).

5. Bering Land Bridge National Preserve consists of 1,127,000 million ha (2,800,000 ac), with 90% of use related to subsistence and local

use activities. NPS has proposed that an additional 121,000 ha (299,520 ac) of the Preserve be designated as Wilderness. Very little sport fishing occurs in the Preserve because better fishing opportunities are available on the Seward Peninsula outside of the Preserve (NPS 1986c).

6. Yukon-Charley Rivers National Preserve is 1,023,000 ha (2,530,000 ac) in size and includes the Charley River and its main tributaries as a Wild and Scenic River. NPS has proposed that 442,380 ha (1,093,120 ac) be designated as Wilderness. Sport fishing is primarily for Arctic grayling, with northern pike found in lower tributary streams and Dolly Varden found in one tributary (NPS 1985c).

A General Management Plan for each unit (except the Yukon-Charley River National Preserve which was completed in 1985) was completed by the NPS in 1987 after taking public and state agency input. General Management plans are intended to establish management direction, determine public access policies, and allowable public uses including priorities for fisheries research within each park unit. It is intended that supplemental plans will be developed in subsequent years to deal with specific fisheries projects, public uses, and access problems.

National Wildlife Refuges:

Refuges are mandated to conserve fish and wildlife habitat, fulfill international treaty obligations, provide for continued subsistence opportunities and ensure water quality. Each refuge has specific legislative purposes and although each is regulated by federal law, the USFWS recognizes a master memorandum of understanding with the State of Alaska which vests primary responsibility for fish and wildlife management with the state, unless subsistence opportunities are compromised. Refuge managers review and adopt ADFG management plans unless the plans are formally determined to be incompatible with the purposes of the refuge. Different management goals exist for each refuge. Policy ranges from that of minimal interference with human use, to that of promotion of increased Wilderness and Wild and Scenic River designations. All guides and outfitters are required to have special use permits in addition to state licenses (for big game guides). There are seven National Wildlife Refuges (NWR) in the AYK Region, and a summary of each follows. Comprehensive Conservation Plans (available from U.S. Fish and Wildlife Service) were completed for all refuges except the Yukon Delta NWR and Arctic NWR in 1987. The plans contain detailed information on the environment, management alternatives, environmental consequences as well as maps for each unit. Step-down plans, more specific plans for fisheries, river management and other public uses of the lands and their resources, will be completed in subsequent years.

1. Selawik NWR is 890,327 ha (2,200,000 ac) in size and includes one Wild and Scenic River and 97,126 ha (240,000 ac) of Wilderness lands. The preferred management alternative is for minimal interference. Mechanized travel to any inholdings, oil and gas studies and recreational opportunities would be allowed.

Recreational use levels are extremely low, with most sport fishing targeting on sheefish in the Kobuk River, adjacent to the NWR (USFWS 1986).

2. Yukon Delta NWR is the largest of Alaska's 16 refuges and consists of 10.52 million ha (26,000,000 ac) including two Wild and Scenic Rivers and 769,000 ha (1,900,000 ac) of Wilderness lands. The management plan permits oil and gas leasing on only 3% of the refuge. Habitat and population manipulation may be conducted on some of the lands. Most sport fishing occurs on the Kisaralik River, but increasing interest from Togiak River fishing guides in establishing commercial guiding on the Andreafsky and Kwethluk rivers and other refuge rivers has been expressed. Rainbow trout are found in the Kwethluk, Kasigluk, Kisaralik, Tuluksak, and Aniak rivers. Sport harvest of sheefish has increased and large numbers of northern pike are caught by locals in the winter. If sport fish guiding increases, the refuge staff envisions conflicts with subsistence users and plans to launch an extensive monitoring program (USFWS 1987a).

3. Yukon Flats NWR is 4,530,000 ha (11,200,000 ac) in size, has two Wild and Scenic Rivers, and borders the Trans-Alaska pipeline. The management plan directs minimal disturbance of habitat and increased wilderness land designations. Limited fly-in sport fishing exists and is mostly incidental to hunting and river running. The Dall River receives the heaviest sport fishing pressure, due to access from the Dalton Highway (USFWS 1985).

4. Koyukuk and Innoko NWR are 1,820,000 and 283,000 ha (4,500,000 and 700,000 ac) in size, respectively. The management plan calls for minimal management. Staff has little information on sport fishing, but believes some occurs in conjunction with hunting and river running (USFWS 1987c).

5. Nowitna NWR consists of 809,389 ha (2,000,000 ac) and one Wild and Scenic River. The management plan is for minimal management. Sport fishing for trophy sheefish is an established activity on the Nowitna River. Northern pike are also sought by anglers. It is believed that most sport fishing occurs in conjunction with hunting (USFWS 1987b).

6. Kanuti NWR is 647,511 ha (1,600,000 ac) in size. The management plan emphasizes the restoration of fish populations to natural and healthy levels. The plan also strives to increase fishing opportunities, but would designate no wilderness areas, and would allow some oil and gas studies (USFWS 1987d).

7. Arctic NWR consists of 7,900,000 ha (19,500,000 ac), four Wild and Scenic Rivers and 3,240,000 ha (8,000,000 ac) of wilderness lands. Section 1002 set aside 607,000 ha (1,500,000 ac) of land on the coastal plain of ANWR for future oil and gas exploration and development pending authorization by the U.S. Congress. The

management plan maintains the existing range and intensity of management and recreational economic uses. Opportunities for fishing and other public uses would be maintained, as would scientific research. Most sport fishing for Arctic grayling, Arctic char, lake trout and northern pike occur in conjunction with river trips and hunting (USFWS 1988).

Float trips on refuge rivers of both the north and south slope are a recognized and growing popular use. The Kongakut River on the north slope is considered most popular, followed by the Hulahula and Canning rivers. The Ivishak and Sagavanirktok rivers are also sometimes used by float parties. The Sheenjek and Porcupine rivers are the most popular south slope rivers for this purpose (USFWS 1988).

Wild and Scenic Rivers:

In the AYK Region, 23 rivers in national parks, preserves and refuges have been placed within the national wild and scenic river system. The Wild and Scenic Rivers Act of 1968 stipulates that these rivers shall be preserved in free flowing condition, generally free of impoundments, and have primitive shorelines and watersheds. The wild and scenic river designation positively impacts utilization of the sport fish resource by affording anglers the possibility of a pristine and uncrowded fishing experience. Access to rivers is controlled and facilities are restricted, thus potentially precluding the development of fishing lodges among other uses. Wild and scenic rivers in the AYK Area are listed in Appendix A.

Wilderness Land Designations:

The Wilderness Act of 1964 restricts modes of access and development on designated parcels of land. Wilderness land designation is intended to promote solitude and primitive recreational opportunities. Depending upon interpretation of the wilderness modifications in ANILCA, land managers may restrict the use of power chain saws, generators, and other similar motors. Stream clearance, weir construction, and field camp operations in wilderness areas in support of fisheries field research may be restricted, depending upon circumstances[4].

Natural Factors Affecting Sport Fisheries

The timing and severity of natural catastrophic events may affect sport fish habitat and life history. Known natural occurrences in 1988 are described and their impacts on sport fish are estimated in the following paragraphs.

Fires:

Fires and fire suppression measures by agencies such as the BLM and State of Alaska, Division of Forestry, are common during the summer months; and, during particularly dry and warm years, forest and tundra fires are a major feature

[4] Artina Cunning. 1988. Personal Communication. ADFG, Division of Wildlife Conservation, PO Box 1148, Nome, AK 99762.

of the climate in Interior and Northern Alaska. Fires in Alaska generally do not penetrate the duff layer to mineral soil and thus do not represent a great potential erosion problem. In addition, frozen ground in large areas of the Arctic and Interior assists in curtailing fire-induced soil erosion. Major impacts of fire on fisheries can occur with the use of earth moving equipment by firefighters to prevent enlargement of a blaze, and aerial deployment of fire retardant. BLM has strict guidelines regarding fire retardant use near water bodies. BLM personnel state that the retardant presently in use is biodegradable and if mistakenly introduced into a water body, would have minimal and short-lived impact on fish populations[5]. Thus, it is the BLM position that fire retardant use in Alaska does not directly threaten fish populations.

The 1988 fire season was the most severe since 1977. A total of 602 unique fire numbers were assigned by the Alaska Fire Service (AFS), of which each of 64 burned more than 40.5 ha (100 ac). Six fires consumed more than 40,500 ha (100,000 ac). A total of 850,5000 ha (2,100,000 ac) burned in 1988, compared to the 5 year average 82,248 ha (203,171 ac). The largest fires occurred in the upper Yukon Zone (BLM 1988).

Snow Pack Assessment:

Snowpack depth and duration impacts fish life history by influencing such factors as water level, sunlight penetration, and insulation of water bodies in periods of extreme cold. Snow survey data obtained from the Soil Conservation Service (USDA 1988) provided snowpack summaries for water year 1988 by region. (Water year 1988, hereafter referred to as WR 88, is the period of time from 1 October 1987 through September, 1988).

In the Arctic, winter snow accumulation was average as of May, 1988. In the Upper Yukon Basin, the basin-wide snowpack at the headwaters of the Yukon River was slightly above average with a maximum snow water equivalent (SWE) value of about 15.7 cm, while SWE in the Central Yukon averaged 10.2 cm in April and was about average. Breakup was earlier than normal in the Tanana Basin, where the SWE was about 5.1 cm in April compared to the average of about 10 cm. In the Koyukuk and Lower Yukon Basin areas SWE was about average, but air temperatures from October through April were well above average. In the Kotzebue Region, snowfall levels were near normal. They were below normal in the Norton Sound Basin. Kuskokwim area winter snowfall was below normal, with SWE of 11.4 cm in April, compared to average values of 15.2 cm.

Stream Discharge Assessment:

Stream flows have a significant impact on fish life history, especially maximum stream discharge events. Stream discharge records were obtained from the U.S. Geological Survey (Bigelow et al. 1989) which give monthly and yearly mean and extreme discharge data by river (Table 15).

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[5] Mark Jones. 1988. Personal Communication. BLM, Alaska Fire Service, PO Box 35005, Ft. Wainwright, AK 99703.

Table 15. Gaging station records[a] of mean and maximum discharge[b] for 1988, and mean and maximum discharge for the period of record, for 10 rivers in AYK.

River	1988		Period of Record		
	Mean	Max	Mean	Max	Years
Kuskokwim at Crooked Cr	37.4	140.0	40.8	392.0	1951-88
Yukon at Eagle	99.1	321.0	83.4	545.0	1950-88
Yukon at Pilot Station	218.7	680.0	223.3	1,100.0	1975-88
Tanana at Fairbanks	22.3	77.9	19.6	96.4	1973-88
Chena at Fairbanks	1.0	7.4	1.4	74.4	1948-88
Salcha near Salchaket	1.3	7.7	1.6	97.0	1948-88
Snake near Nome	0.2	2.1	0.2	4.2	1965-88
Kobuk near Kiana	13.6	80.0	14.8	152.0	1976-88
Wulik near Kivalina	0.9	29.0	-	29.0	1984-88
Kuparuk near Deadhorse	1.3	31.6	1.3	118.0	1971-88
Sagavanirktok, Pump 3	1.3	7.8	1.3	23.0	1982-88

[a] Data from USGS 1988
[b] Cubic feet per second x 1,000.

Of the streams in the AYK Region for which discharge data are collected, some Yukon River sites (Table 15) had mean discharge rates in WR 88 that exceeded the annual mean discharge of all years of record. However, maximum discharges in 1988 at those locations did not approach the maximum recorded flows. Maximum discharges at all sites in WR 88 did not exceed maximum flow in the years of record. No serious flooding and streambed disruption was noted during the summer of 1988 in any AYK Region drainage.

Mean Air Temperature and Precipitation:

Average annual temperature and precipitation regimes influence the timing of stream freeze up and break up occurrences, and by affecting the duration and severity of the seasons, plays a major role in the annual water budget. Climatological data for four cities in the AYK Region (Fairbanks, Nome, Kotzebue and Barrow) were obtained from the US Weather Service (NOAA 1989). The mean monthly and yearly temperature (F) and precipitation (inches) for the period of record (1958-1988) are provided by this source. Climatological data from only four locations may not adequately represent microclimatic conditions throughout the region, but may provide an indication of seasonal weather patterns in the AYK Region.

Mean monthly air temperatures in WY 1988 for the four cities were generally slightly elevated over the historic means. In northwest Alaska (Nome and Kotzebue), a distinct midwinter rise in temperatures was noted in December and January 1988 (Figure 25).

Mean monthly precipitation values for WY 1988 for the four cities are much more variable than temperature means. The interior, as judged from the precipitation records from Fairbanks, experienced below average moisture from October 1987 to April 1988, and then experienced higher than average precipitation in May and June 1988. Higher than normal precipitation was recorded in August 1988 in Barrow, Nome and Kotzebue (Figure 26).

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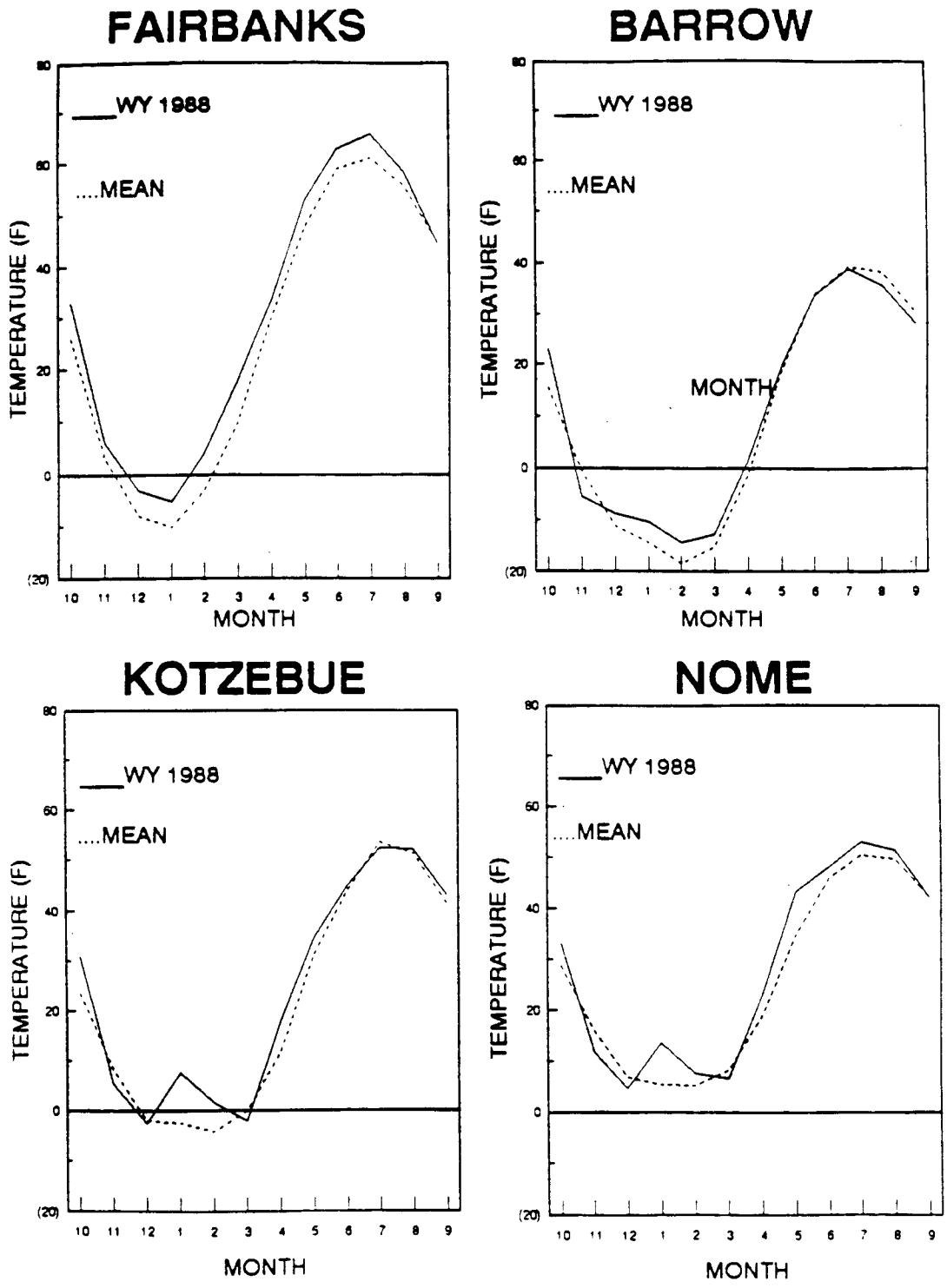

Figure 25. Monthly mean air temperature for the 1988 water year compared to monthly mean air temperature, 1958-1988, in four AYK locations.

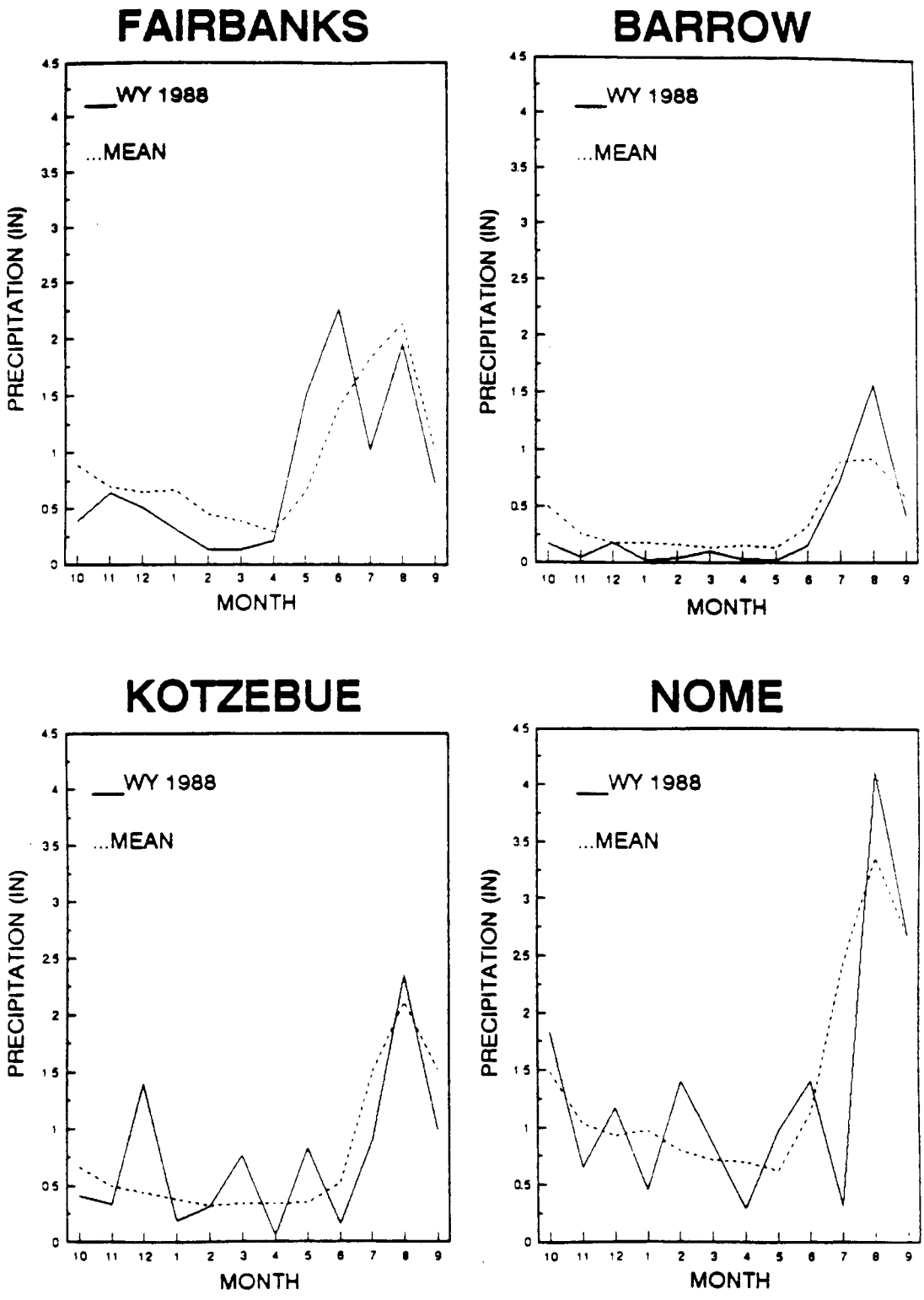

Figure 26. Mean monthly precipitation for water year 1988 compared to mean monthly precipitation, 1958-1988, in four AYK locations.

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APPENDIX A

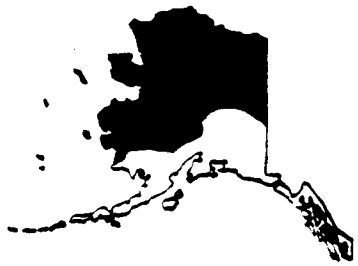
Appendix A. Wild and Scenic Rivers in the Arctic-Yukon-Kuskokwim Region.

River	Federal Unit or Area
Alatna	Gates of the Arctic National Park
John	Gates of the Arctic National Park
Kobuk	Gates of the Arctic National Park
Upper Noatak	Gates of the Arctic National Park
North Fork of the Koyukuk	Gates of the Arctic National Park
Tinayguk	Gates of the Arctic National Park
Salmon	Kobuk Valley National Park
Charley	Yukon-Charley Preserve
Upper Selawik	Selawik National Wildlife Refuge
Andreafsky and East Fork	Yukon Delta National Wildlife Refuge
Nowitna (a 357 km section)	Nowitna National Wildlife Refuge
Ivishak	Arctic National Wildlife Refuge
Upper Sheenjek	Arctic National Wildlife Refuge
Wind	Arctic National Wildlife Refuge
Upper Unalakleet	Norton Sound
Upper Beaver Creek	Interior Alaska
Birch Creek	Interior Alaska
Delta	Interior Alaska

APPENDIX B

Appendix B. AYK Region sport fishing regulations summary for 1988.

ARCTIC—YUKON—KUSKOKWIM AREA



This is a summary of the official regulations codified in 5 AAC 70.001-050 which are available for inspection at libraries, department offices, and Department of Public Safety offices throughout the state.

The Arctic—Yukon—Kuskokwim area consists of all waters of Alaska, including the Bering Sea, Chukchi Sea, and Arctic Ocean drainages, north of a line extending west from Cape Newenham, and west of the International Boundary near Demarcation Point, excluding all waters of the Tanana River Drainage.

INSTRUCTIONS:

1. Find the water (alphabetically listed) that you intend to fish. If the water, or any portion of it, is not listed, the regulations in the shaded entry apply.
2. Use the Code Key to determine open season, catch, and length limits. Read Special Regulations
3. An asterisk(*) denotes Special Regulations apply

WATER AND SPECIAL REGULATIONS	SEASON AND CATCH LIMIT					
	SALMON	DOLLY VARDEN/ ARCTIC CHAR/ LAKE TROUT/ RAINBOW/ GRAYLING	SHEEFISH	NORTHERN PIKE/ BURBOT	HALIBUT	OTHER FISH
All waters not listed below	A,C	F,G,J,I	L	N,P		R
Kivalina River drainage:	C	G,K,I	L	N,P		R
Kobuk River drainage:						
upstream of the mouth of Mauneluk River	C	G,J,I	M	N,P		R
remainder of the Kobuk River	C	G,J,I	L	N,P		R
Kuskokwim Bay drainages: All waters that drain into Kuskokwim Bay (excluding the Kuskokwim River) from Cape Avinof to Cape Newenham **Special Regulations:** No person may sport fish from a boat or the river bank within 300 feet of a legally operating subsistence set gillnet on the Goodnews or Kanektok River downstream of the Togiak National Wildlife Refuge wilderness area boundary	A,E	F,G,J,I	L	N,P	Q	R
Kuskokwim River drainage:	B,E	F,G,J,I	L	N,P		R
Nootak River drainage:	C	G,K,I	L	N,P		R
Seward Peninsula waters: (All waters draining into the Bering Sea from Cape Darby to Cape Prince of Wales on the Seward Peninsula) **Special Regulations:** *Salmon Lake, its tributaries, and the outlet stream 300 feet downstream from the lake outlet are closed to salmon fishing.	B*,D*	H,J		N,P		R
Trans-Alaska Pipeline (A corridor 5 miles wide on each side of the alignment.)	Closed	G,J,I	L	N,P		R
Unalakleet River drainage:	B,C	H,J		N,P		R
Wulik River drainage:	C	G,K,I	L	N,P		R
Yukon River drainage:						
from the mouth of the Tanana River upstream to, and including, the Hodzana River	A,C	G,J,I	L	O,P		R
remainder of the drainage	A,C	G,J,I	L	N,P		R

OTHER ARCTIC—YUKON—KUSKOKWIM AREA REGULATIONS

METHODS AND MEANS. 1. In all lakes, multiple hooks with gap between point and shank greater than one-half inch may be used for taking fish other than salmon.

2. Sucker and Burbot, may be taken by spear or bow and arrow from January 1 through December 31.

3. Northern Pike and Whitefish (excluding sheefish) may be taken by spear or bow and arrow from September 1 through April 30 and may be speared by persons completely submerged from January 1 through December 31.

CODE KEY: ARCTIC-YUKON-KUSKOKWIM AREA Use these codes to determine open season, catch and length limits.

CODE		OPEN SEASON	BAG, POSSESSION, AND SIZE LIMITS
A	KING SALMON	Entire Year	3 per day, 3 in possession, only 2 can exceed 20 inches
B	KING SALMON	Entire Year	1 per day, 1 in possession, no size limit
C	OTHER SALMON	Entire Year	10 per day, 10 in possession, no size limit
D	OTHER SALMON	Entire Year	10 per day, 10 in possession, only 3 which may be chum salmon and coho salmon, in combination
E	OTHER SALMON	Entire Year	5 per day, 5 in possession, no size limit

F	RAINBOW TROUT	Entire Year	2 per day, 2 in possession, no size limit
G	GRAYLING	Entire Year	10 per day, 10 in possession, no size limit
H	GRAYLING	Entire Year	5 per day, 5 in possession, only 1 over 15 inches
I	LAKE TROUT	Entire Year	4 per day, 4 in possession, no size limit
J	ARCTIC CHAR/DOLLY VARDEN	Entire Year	10 per day, 10 in possession, no size limit
K	ARCTIC CHAR/DOLLY VARDEN	Entire Year	10 per day, 10 in possession, only 2 over 20 inches
L	SHEEFISH	Entire Year	10 per day, 10 in possession, no size limit
M	SHEEFISH	Entire Year	2 per day, 2 in possession, no size limit
N	NORTHERN PIKE	Entire Year	10 per day, 10 in possession, no size limit
O	NORTHERN PIKE	Entire Year	5 per day, 5 in possession, only 1 over 30 inches
P	BURBOT	Entire Year	15 per day, 15 in possession, no size limit
Q	HALIBUT	Feb. 1—Dec. 31	2 per day, 2 in possession, no size limit
R	OTHER FISH	Entire Year	No bag, possession or size limit

TANANA AREA

This is a summary of the official regulations codified in 5 AAC 70.001-050 (as they apply to waters of the Tanana River Drainage) which are available for inspection at libraries, department offices, and Department of Public Safety offices throughout the state.

The Tanana River area consists of all waters of the Tanana River drainage.

INSTRUCTIONS:

1. Find the water (alphabetically listed) that you intend to fish. If the water, or any portion of it, is not listed, the regulations in the shaded entry apply.
2. Use the Code Key to determine open season, catch, and length limits. Read Special Regulations.
3. An asterisk(*) denotes Special Regulations apply.

SEASON AND CATCH LIMIT

WATER AND SPECIAL REGULATIONS	SALMON	DOLLY VARDEN/ ARCTIC CHAR/ LAKE TROUT/ RAINBOW/ GRAYLING	WHITEFISH/ SHEEFISH	NORTHERN PIKE/ BURBOT	OTHER FISH
All waters not listed below	A,B	C,D,F,I,L	M,N	O,Q,R	T
Chena River and its tributaries:					
downstream from a department marker 300 feet downstream from the Chena River flood control structure	A,B	H*	M,N	O,R	T
remainder of drainage	Closed	H*	M,N	O,R	T
Special Regulations: (Unless otherwise specified, each special regulation applies to the entire Chena River and its tributaries) 1. Upstream of the Chena River Dam, only unbaited, artificial lures or flies may be used. 2. Downstream of the Chena River Dam, bait may be used only on hooks with a gap size larger than ¾ inch. 3. *Grayling may not be possessed or retained from April 1 to the first Saturday in June; all grayling caught between these dates must be released immediately. 4. The Chena River from the confluence of the South Fork (river mile 77) to the first bridge (river mile 88) is designated a catch and release water for grayling. Grayling may not be possessed or retained. All grayling caught must be released immediately.					
Delta Clearwater River and its tributaries:	B	H*	M,N	O,R	T
Special Regulations: 1. Only unbaited artificial lures or flies may be used. 2. *Grayling may not be possessed or retained from April 1 to the first Saturday in June; all grayling caught between these dates must be released immediately.					

TANANA AREA

WATER AND SPECIAL REGULATIONS	SEASON AND CATCH LIMIT				
	SALMON	DOLLY VARDEN/ ARCTIC CHAR/ LAKE TROUT/ RAINBOW/ GRAYLING	WHITEFISH/ SHEEFISH	NORTHERN PIKE/ BURBOT	OTHER FISH
Fielding Lake **Special Regulations:** *No set lines may be used.		F,J	N	S*	T
Goodpaster River drainage:	Closed	F	M,N	O,R	T
Harding Lake **Special Regulations:** *No set lines may be used.	A,B	C,F,J	M,N	O,S*	T
Mineral Lake Outlet (From the outlet of Mineral Lake to its confluence with the Little Tok River) **Special Regulations:** 1. Only unbaited artificial lures or flies may be used. 2. *Grayling may not be possessed or retained from April 1 to the first Saturday in June; all grayling caught between these dates must be released immediately.		H*	M,N	O,R	T
Piledriver Slough upstream from its confluence with Moose Creek: **Special Regulations:** Only unbaited artificial lures or flies may be used.	B	D,G	M,N	O,R	T
Richardson Clearwater River drainage: **Special Regulations:** 1. Only unbaited artificial lures or flies may be used. 2. *Grayling may not be possessed or retained from April 1 to the first Saturday in June; all grayling caught between these dates must be released immediately.	B	H*	M,N	O,R	T
Salcha River and its tributaries: downstream from a marker placed approximately 2½ miles upstream from the Richardson Hwy. Bridge: upstream from a marker placed approximately 2½ miles upstream from the Richardson Hwy. Bridge: **Special Regulations:** 1. Only unbaited artificial lures or flies may be used. 2. *Grayling may not be possessed or retained from April 1 to the first Saturday in June; all grayling caught between these dates must be released immediately. 3. Fishing from the Richardson Hwy. Bridge over the Salcha River is prohibited.	A,B Closed	H* H*	M,N M,N	O,R O,R	T T
Sansing Lake	A,B	E,F			
Shaw Creek and its tributaries: **Special Regulations:** 1. Only unbaited artificial lures or flies may be used upstream of the Richardson Hwy. Bridge. 2. Downstream of the Richardson Hwy. Bridge, bait may be used only on hooks with a gap size larger than ¾ inch. 3. *Grayling may not be possessed or retained from April 1 to the first Saturday in June in Shaw Creek drainage and the Tanana River from 2 miles upstream of the mouth of Shaw Creek to 2 miles downstream of the mouth of Shaw Creek; all grayling caught between these dates must be released immediately.	B	H*	M,N	O,R	T
"T" Lake **Special Regulations:** *No set lines may be used.			N	O,S*	T
Tangle Lakes **Special Regulations:** *No set lines may be used.		F,K	N	S*	T
Tolovana River drainage (Includes Minto Flats, Chatanika River, Tatalina River, and Goldstream Creek:	A,B	F	M,N	P,R	T

CODE KEY: TANANA AREA Use these codes to determine open season, catch and length limits.

CODE		OPEN SEASON	BAG, POSSESSION, AND SIZE LIMITS
A	KING SALMON		
	16 inches or more	Entire Year	1 per day, 1 in possession
	Less than 16 inches	Entire Year	10 per day, 10 in possession
B	OTHER SALMON		
	16 inches or more	Entire Year	3 per day, 3 in possession
	Less than 16 inches	Entire Year	10 per day, 10 in possession
C	RAINBOW TROUT (In Lakes)		
	20 inches or more	Entire Year	2 per day, 2 in possession
	Less than 20 inches	Entire Year	10 per day, 10 in possession

TANANA AREA

D	**RAINBOW TROUT (Flowing waters)**	Entire Year	5 per day, 5 in possession, no size limit
E	**RAINBOW TROUT**	Entire Year	3 per day, no size limit
F	**GRAYLING**	Entire Year	5 per day, 5 in possession, no size limit
G	**GRAYLING**	Entire Year	5 per day, 5 in possession, 12 inch minimum length limit
H	**GRAYLING**	First Saturday in June through March 31	5 per day, 5 in possession, 12 inch minimum length limit
I	**LAKE TROUT**	Entire Year	2 per day, 2 in possession, no size limit
J	**LAKE TROUT**	Entire Year	2 per day, 2 in possession, 18 inch minimum length limit
K	**LAKE TROUT**	Entire Year	1 per day, 1 in possession, 18 inch minimum length limit
L	**ARCTIC CHAR/DOLLY VARDEN**	Entire Year	10 per day, 10 in possession, no size limit
M	**SHEEFISH**	Entire Year	2 per day, 2 in possession, no size limit
N	**WHITEFISH (Excluding Sheefish)**	Entire Year	15 per day, 15 in possession, no size limit
O	**NORTHERN PIKE**	Entire Year	5 per day, 5 in possession, only 1 over 30 inches
P	**NORTHERN PIKE**	June 1 through October 14	5 per day, 5 in possession, only 1 over 30 inches
Q	**BURBOT (In Lakes)**	Entire Year	5 per day, 5 in possession, no size limit
R	**BURBOT (Flowing Waters)**	Entire Year	15 per day, 15 in possession, no size limit
S	**BURBOT**	Entire Year	2 per day, 2 in possession, no size limit
T	**OTHER FISH**	Entire Year	No bag, possession or size limit

OTHER TANANA AREA REGULATIONS

METHODS AND MEANS. (1) In all lakes, multiple hooks with gap between point and shank greater than one-half inch may be used for taking fish other than salmon.

(2) Suckers and burbot may be taken by spear or bow and arrow from January 1 through December 31.

(3) Northern pike and whitefish (excluding sheefish) may be taken by spear or bow and arrow from September 1 through April 30 and may be speared by persons completely submerged from January 1 through December 31.

(4) Burbot may be taken by set lines in all lakes in the Tanana River drainage (except for Fielding, Harding, "T", and Tangle Lakes) from October 15 through May 15.

(5) Burbot may be taken by set lines in rivers year round.

(6) The total aggregate number of hooks used on set lines, closely attended gear, and ice fishing gear may not exceed the daily bag limit for burbot in the water being fished.

(7) All ice houses not removed from the ice at the end of the day's fishing must be registered and a permit secured from the Department. Each registered ice house must have permit numbers displayed on its side and roof in distinguishable numbers not less than 12 inches in height.

APPENDIX C

Appendix C. Partial listing of wilderness lodges, guiding and outfitting operations in the AYK Region.

Location	Operation	Remarks
Seward Peninsula/Norton Sound:		
White Mtn.	Fishing lodge, guiding	Opened in 1986
Niukluk, Fish R.	Outfitters	
Unalakleet R.	1 lodge	
Kuskokwim:		
Tonzona R.	2 lodges	Includes hunting
Holitna R.	2 lodges, 6 guides	Includes hunting
Hoholitna R.	1 lodge	
Aniak R.	6 guides, misc. outfitters	
Arctic:		
Kobuk R.	a few small lodges (20 guests)[1]	
Walker Lk.	1 lodge	
Alatna R.	1 lodge	

[1] NPS encourages nonconsumptive use of Kobuk Valley Park, so these lodges may offer more for the sightseer than the angler.